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Rhee

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(54) **DISPLAY APPARATUS USING SEMICONDUCTOR LIGHT EMITTING DEVICE**

(71) Applicant: **LG ELECTRONICS INC.**, Seoul (KR)

(72) Inventor: **Byungjoon Rhee**, Seoul (KR)

(73) Assignee: **LG ELECTRONICS INC.**, Seoul (KR)

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G06F 3/041 (2006.01)
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CPC ***G06F 3/0416*** (2013.01); ***G02B 5/201*** (2013.01); ***G06F 3/044*** (2013.01); ***G06F 3/0412*** (2013.01);
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(58) **Field of Classification Search**
None
See application file for complete search history.

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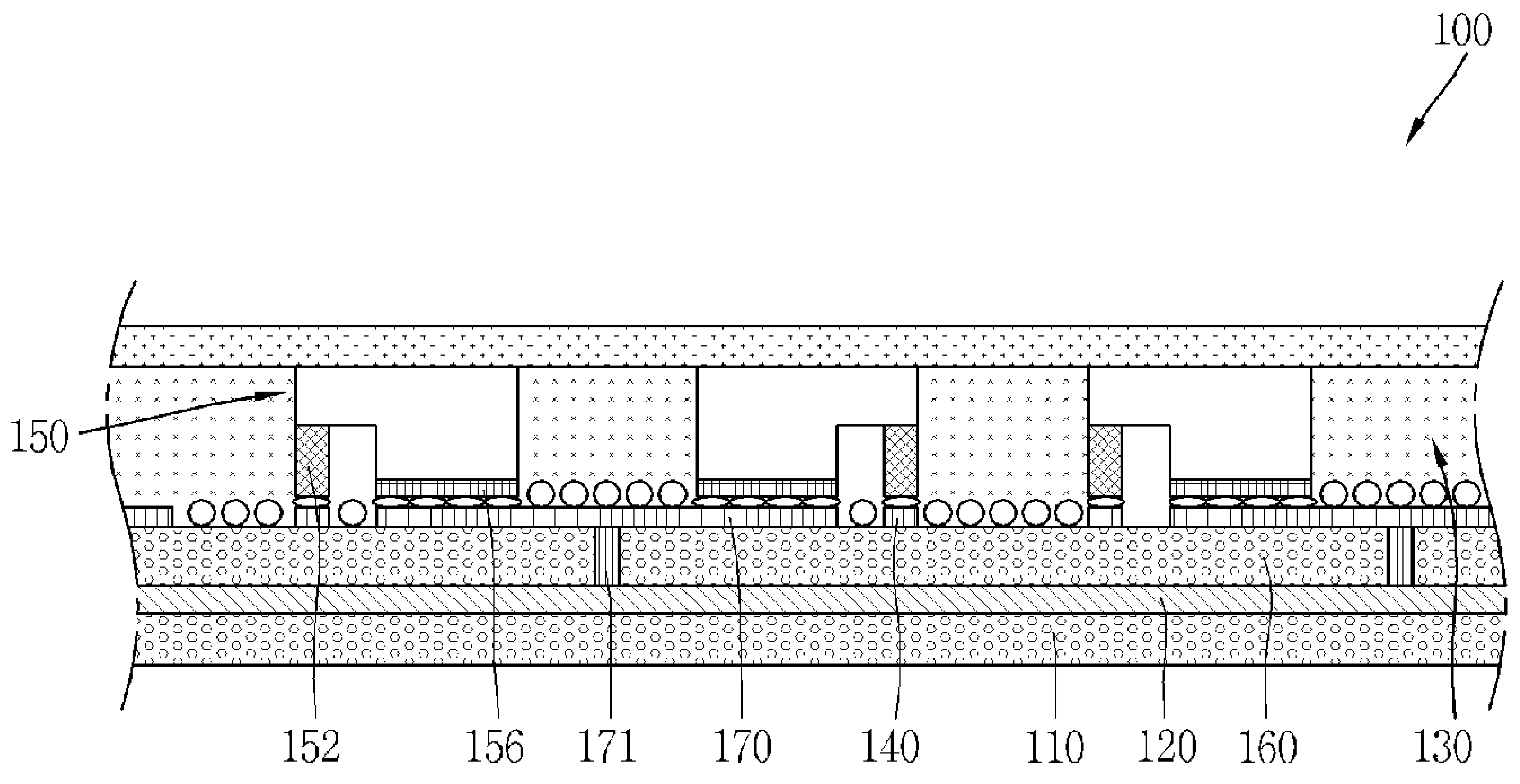
Primary Examiner — Duane N Taylor, Jr.
(74) *Attorney, Agent, or Firm* — Lee, Hong, Degerman, Kang & Waimey

(57) **ABSTRACT**

The present invention relates to a display apparatus and, more particularly, to a display apparatus using a semiconductor light emitting device. In the display apparatus including a touch sensor unit and a display unit controlled based on a touch input sensed through the touch sensor unit, the display unit includes: a conductive bonding layer; and a plurality of semiconductor light emitting devices bonded to the conductive bonding layer and arranged to form a plurality of rows, and the touch sensor unit includes: an X electrode disposed between the plurality of rows of the semiconductor light emitting devices in the display unit; and an Y electrode configured to be combined with the X electrode to sense a touch input.

12 Claims, 14 Drawing Sheets



(51) **Int. Cl.**

G02B 5/20	(2006.01)
H01L 25/075	(2006.01)
H01L 33/32	(2010.01)
H01L 33/42	(2010.01)
H01L 33/50	(2010.01)
H01L 33/58	(2010.01)
H01L 33/62	(2010.01)

(52) **U.S. Cl.**

CPC ***H01L 25/0753*** (2013.01); ***H01L 33/32*** (2013.01); ***H01L 33/42*** (2013.01); ***H01L 33/502*** (2013.01); ***H01L 33/58*** (2013.01); ***H01L 33/62*** (2013.01); *G06F 2203/04101* (2013.01); *G06F 2203/04102* (2013.01); *G06F 2203/04107* (2013.01); *G06F 2203/04111* (2013.01)

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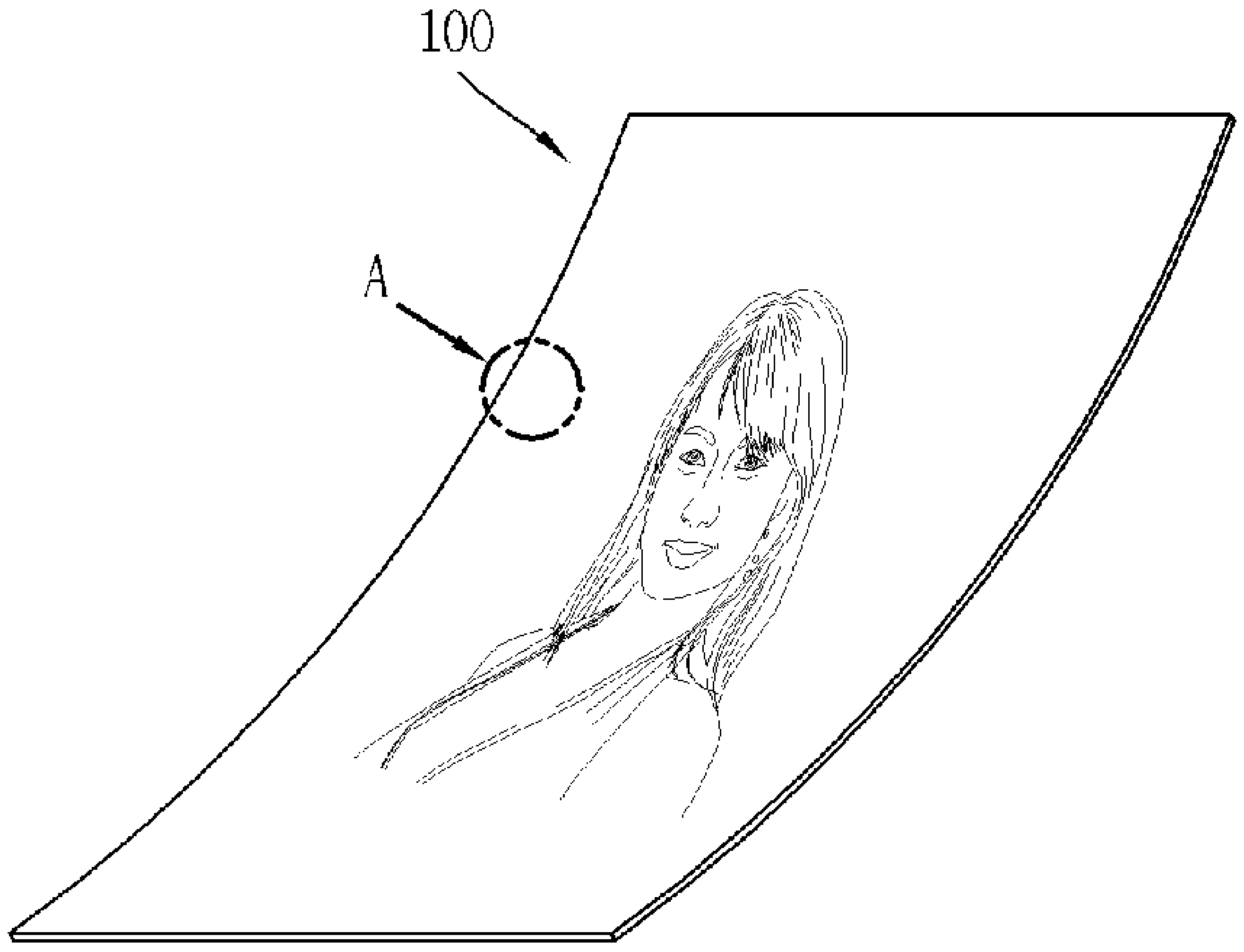
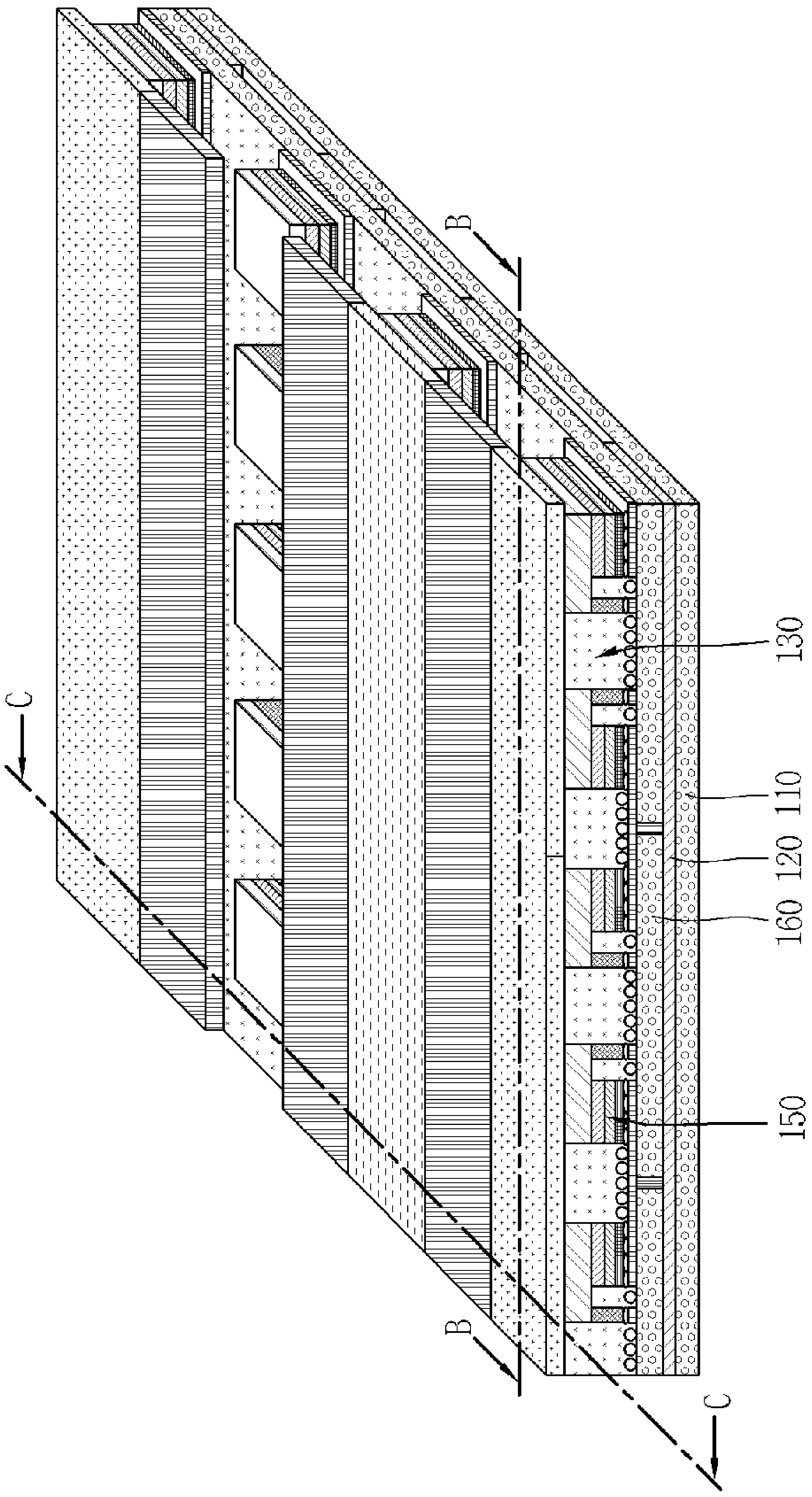
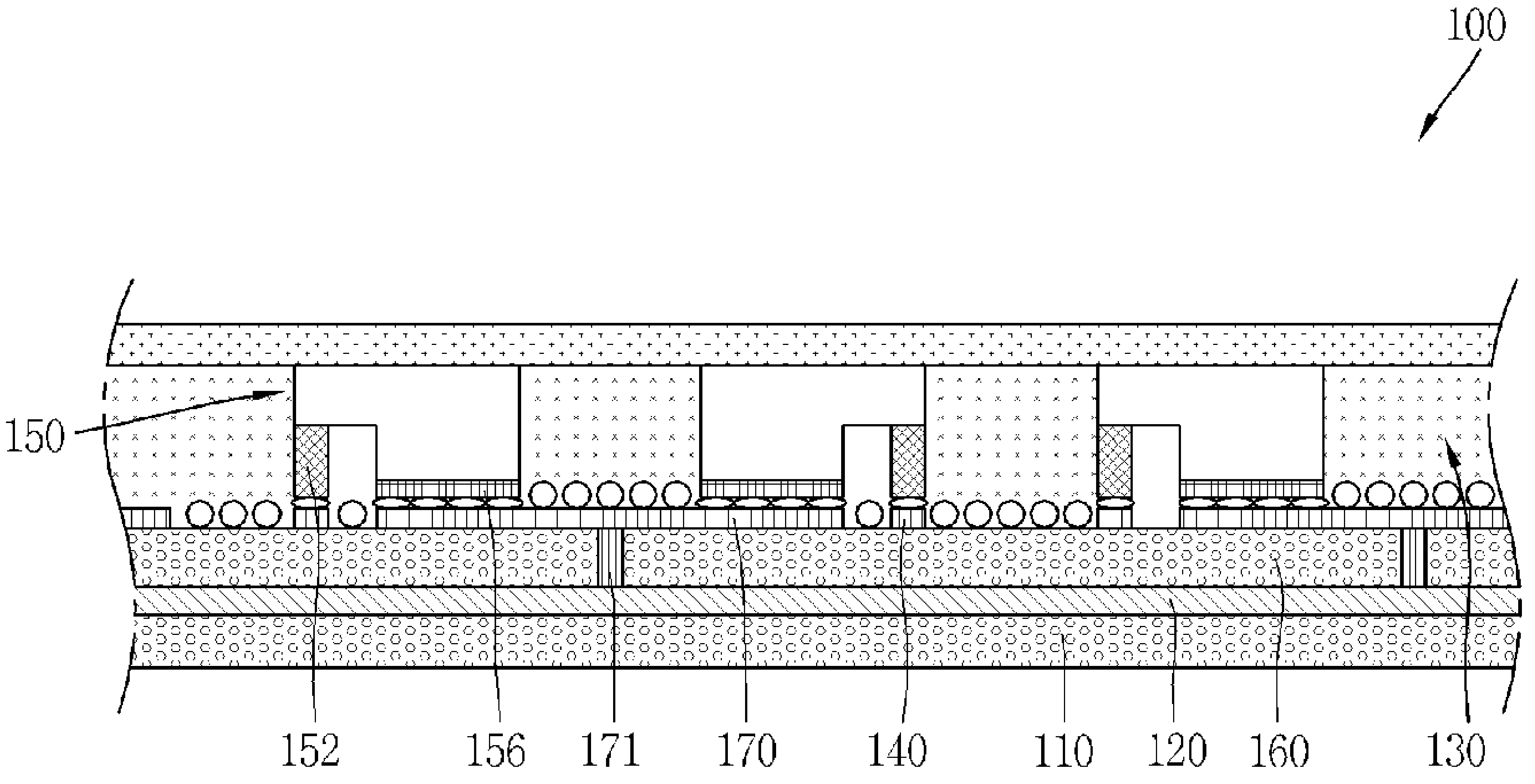
[Fig. 1]



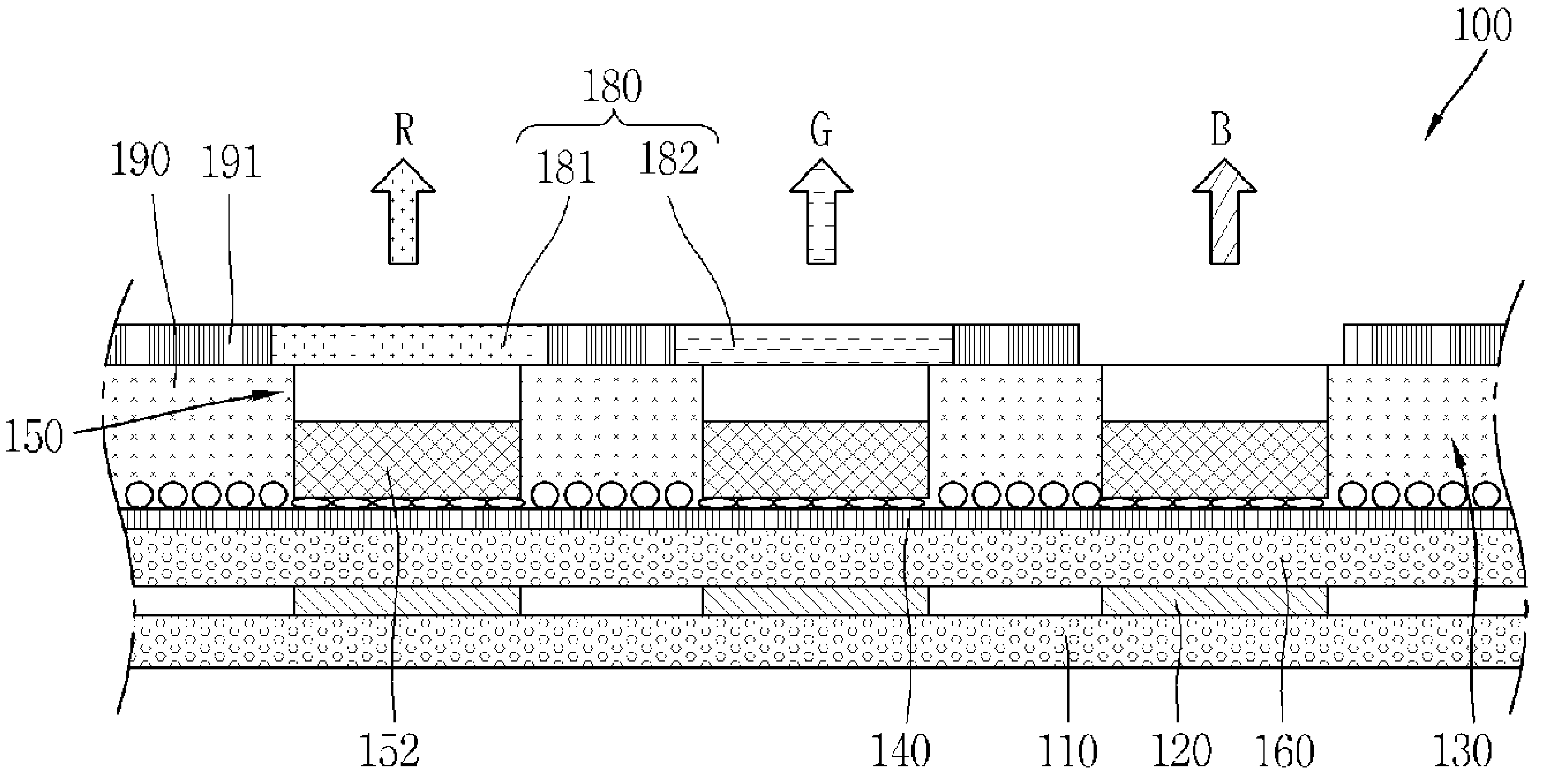
[Fig. 2]



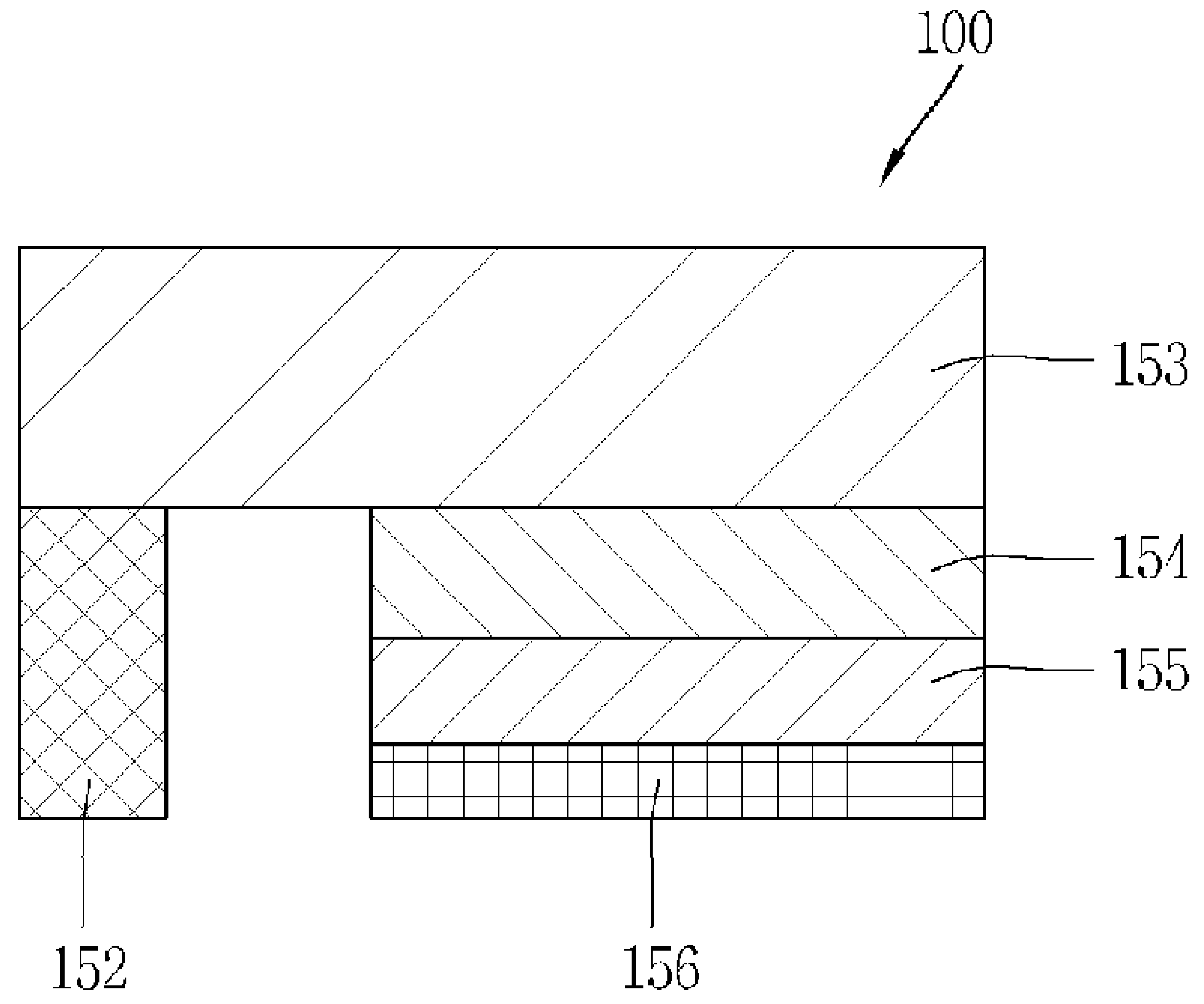
[Fig. 3a]



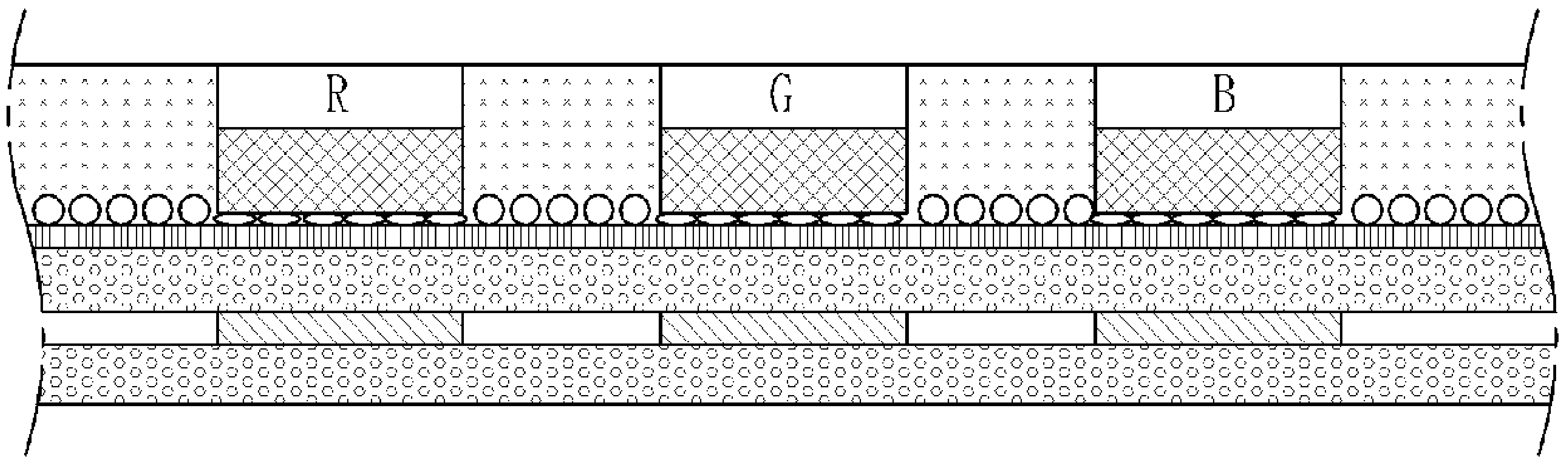
[Fig. 3b]



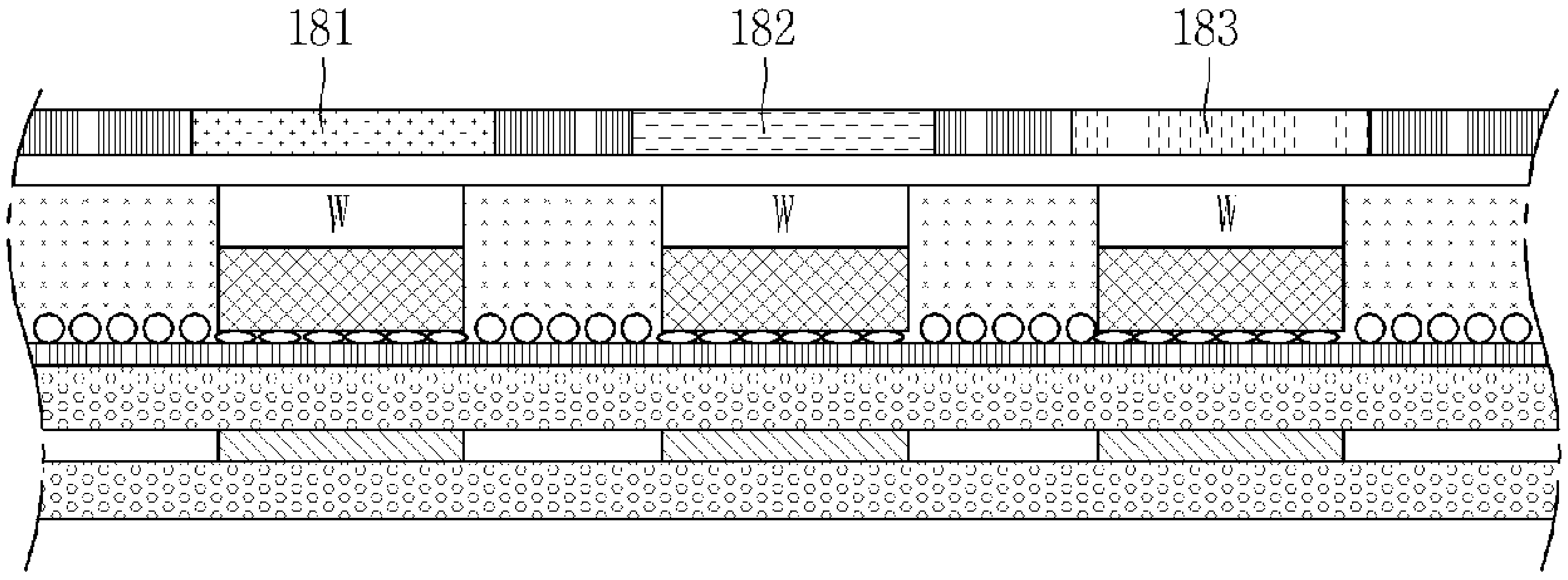
[Fig. 4]



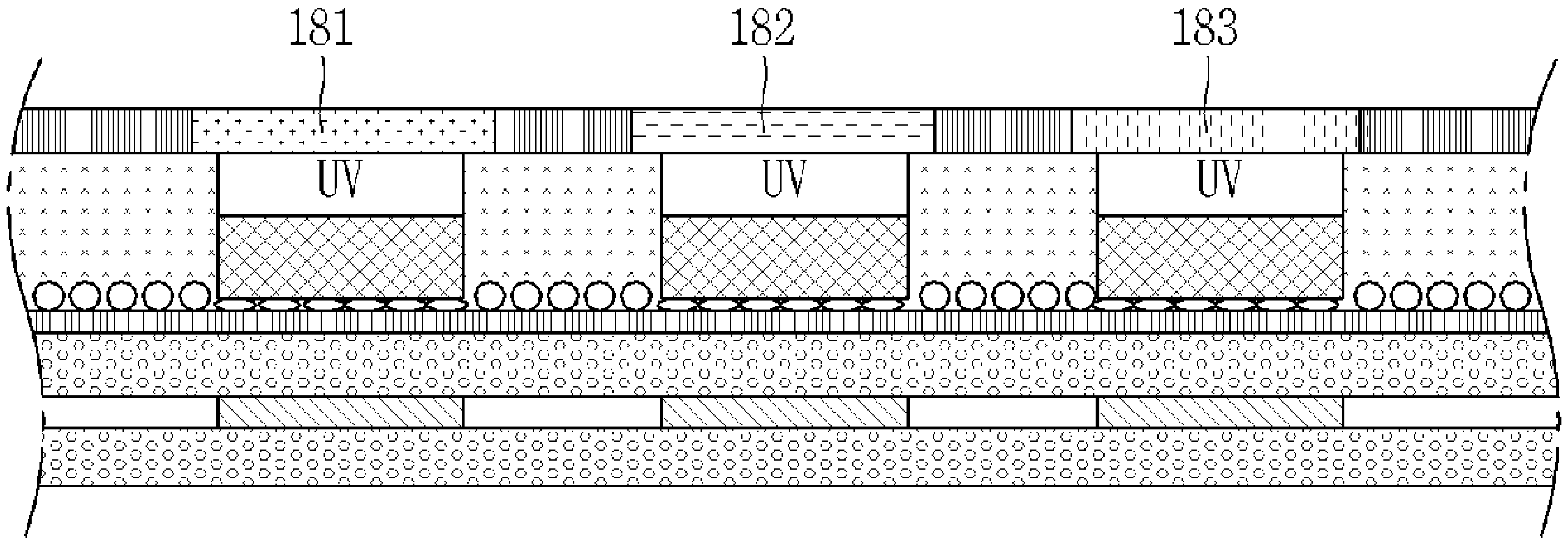
[Fig. 5a]



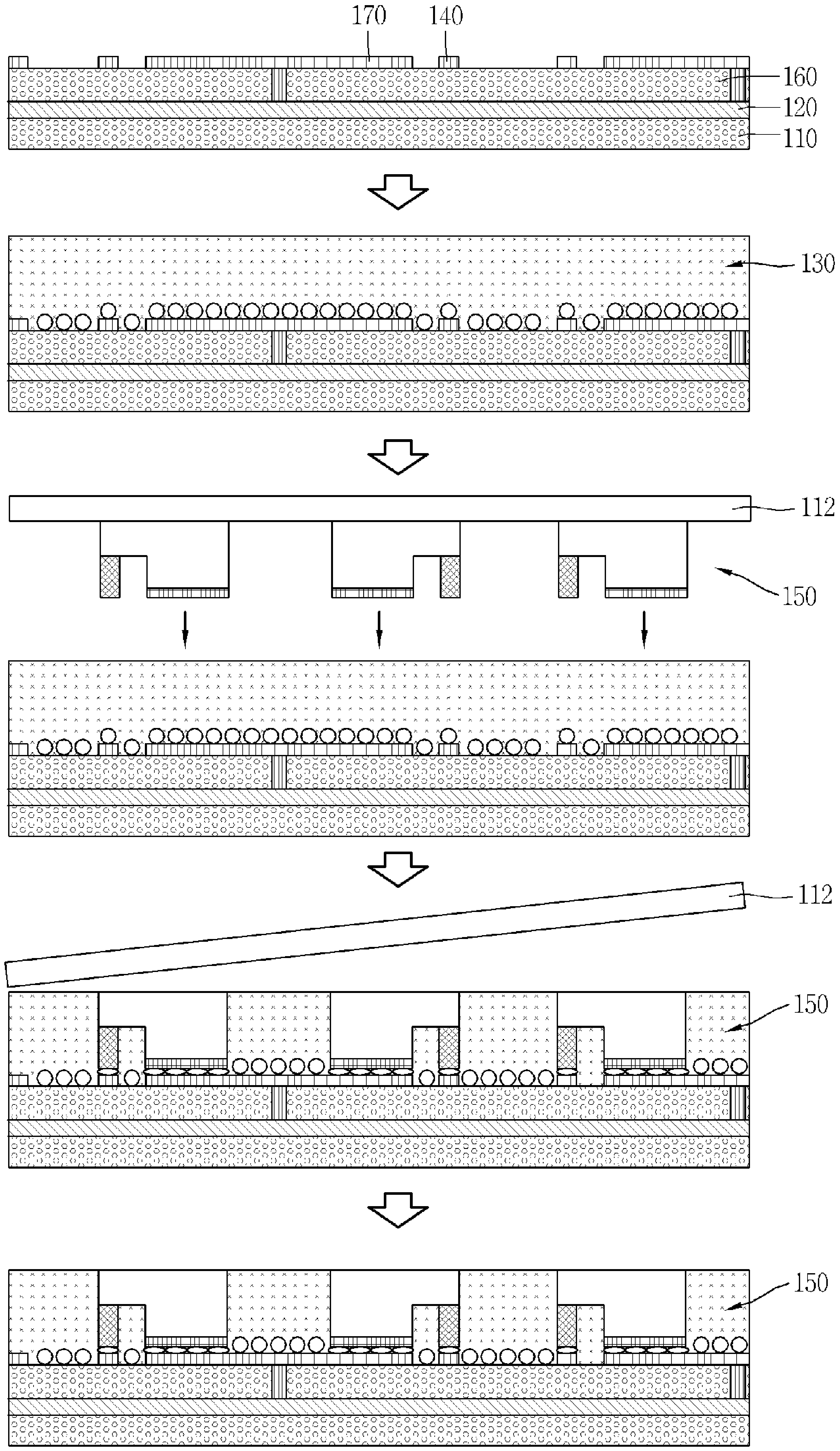
[Fig. 5b]



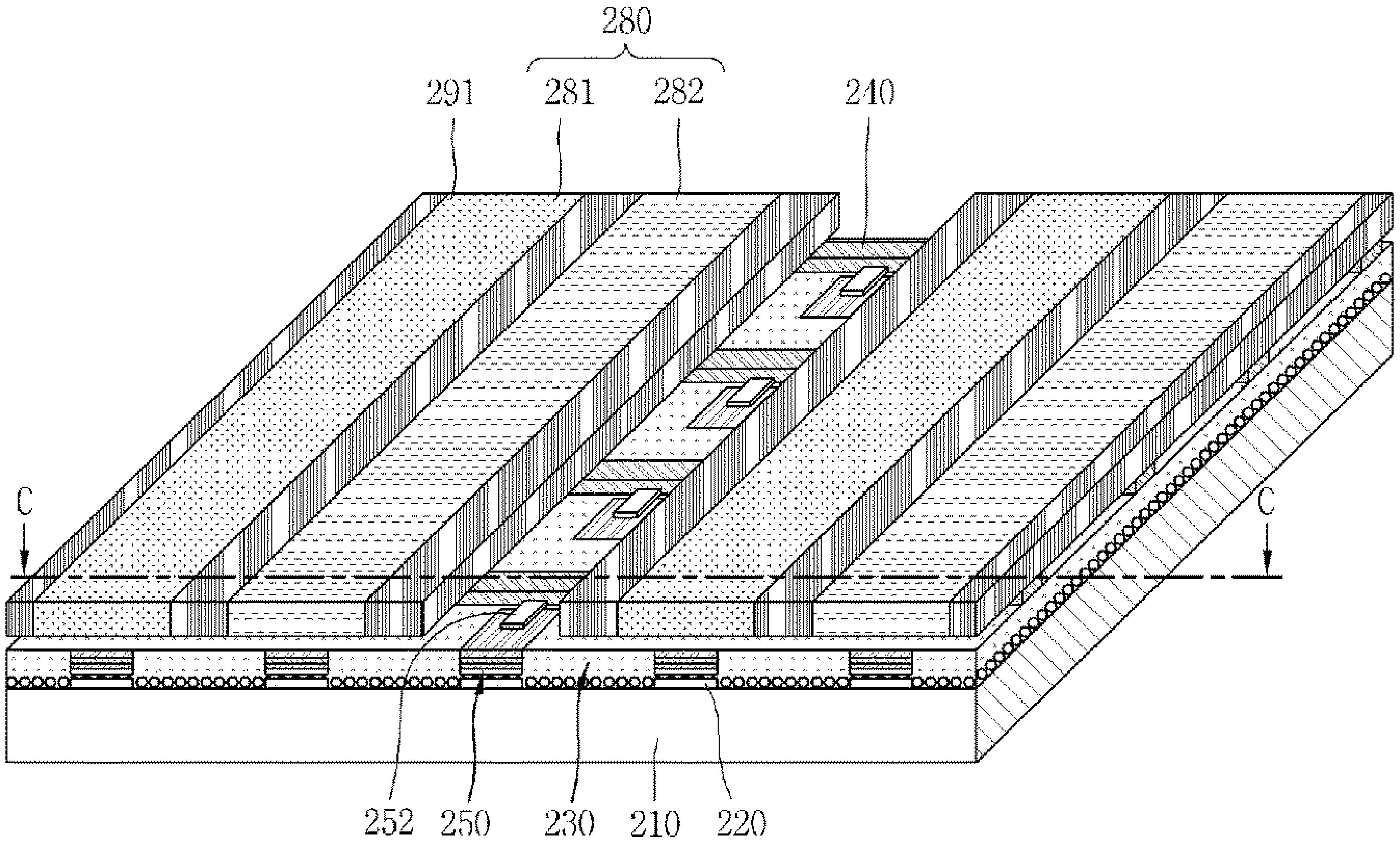
[Fig. 5c]



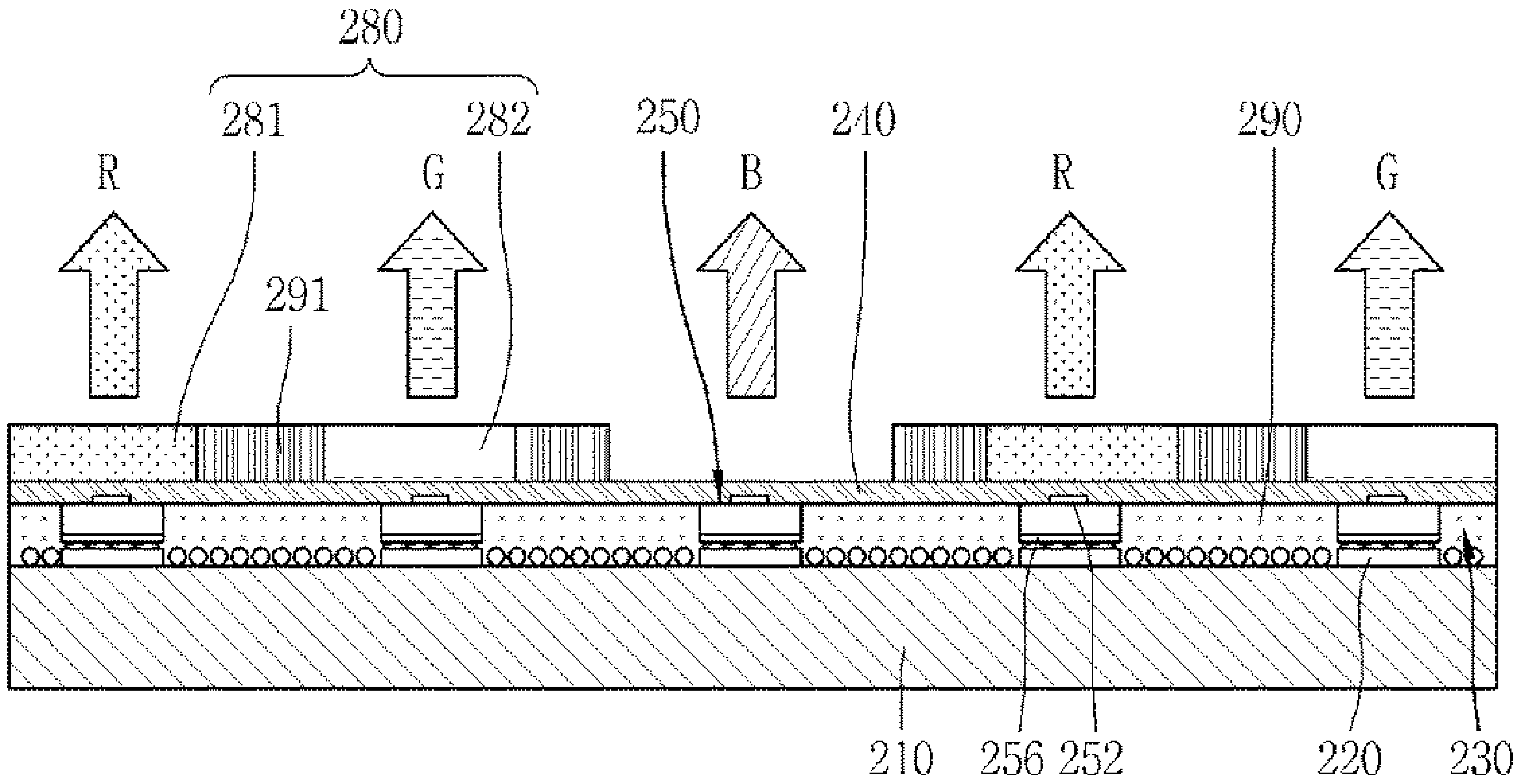
[Fig. 6]



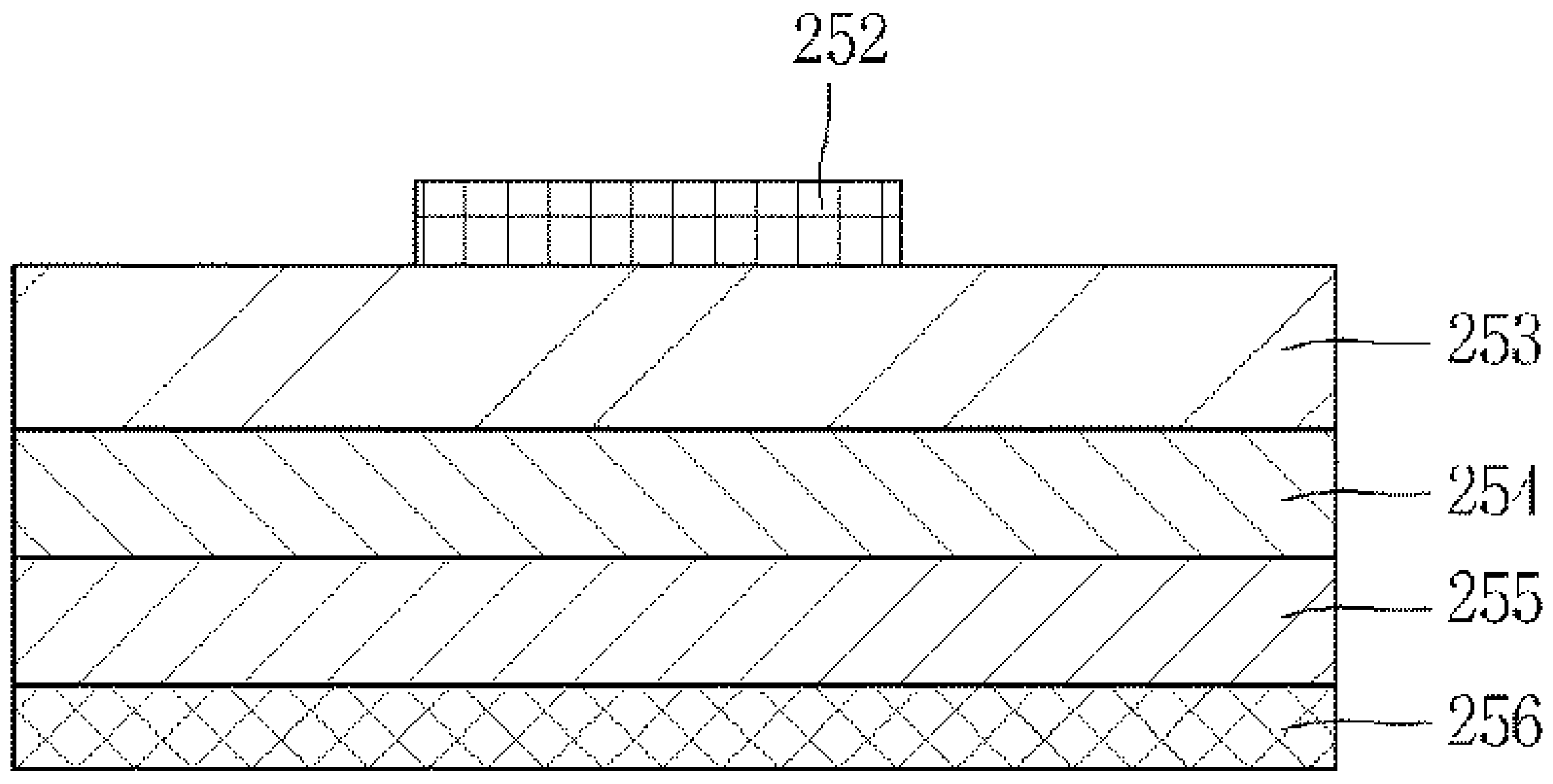
[Fig. 7]



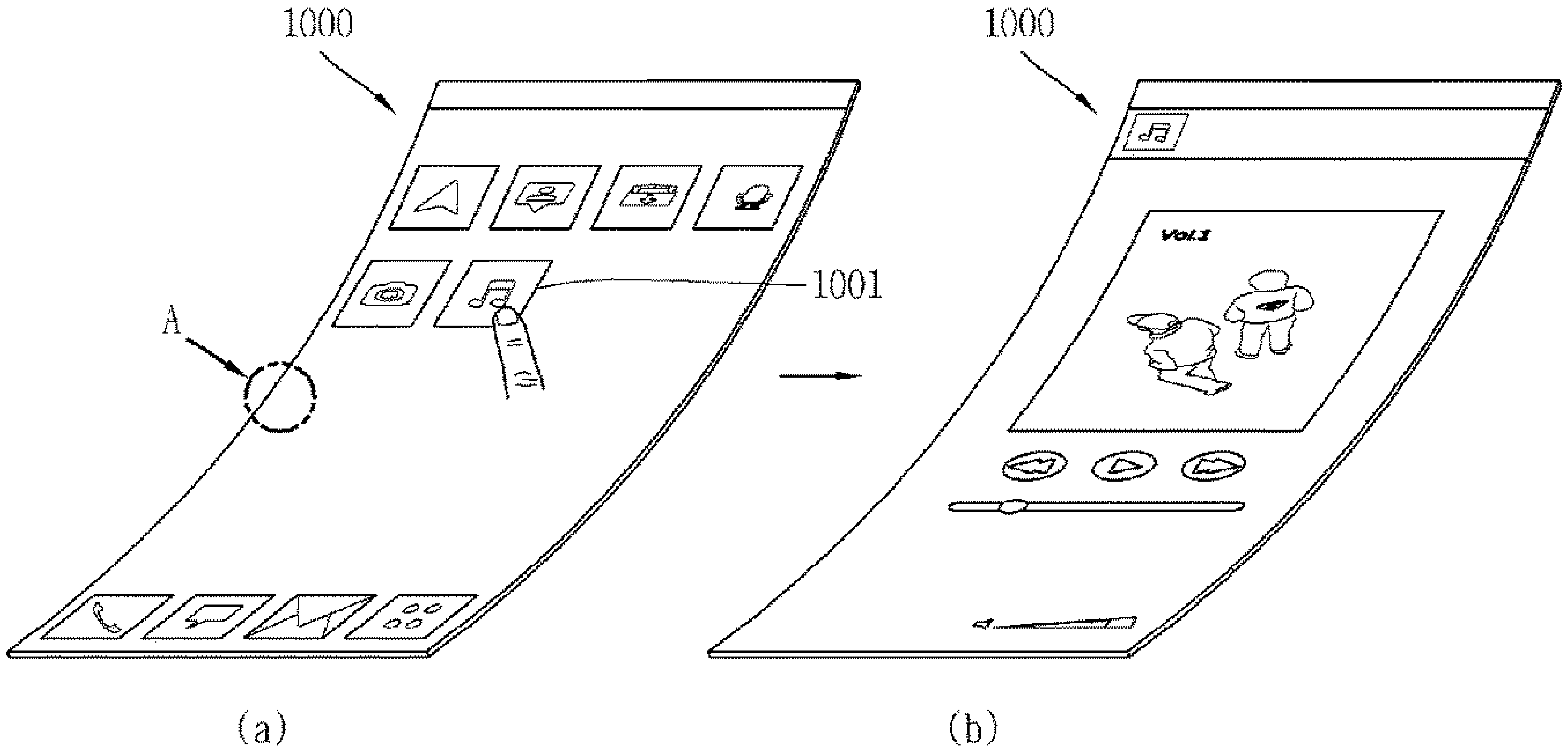
[Fig. 8]



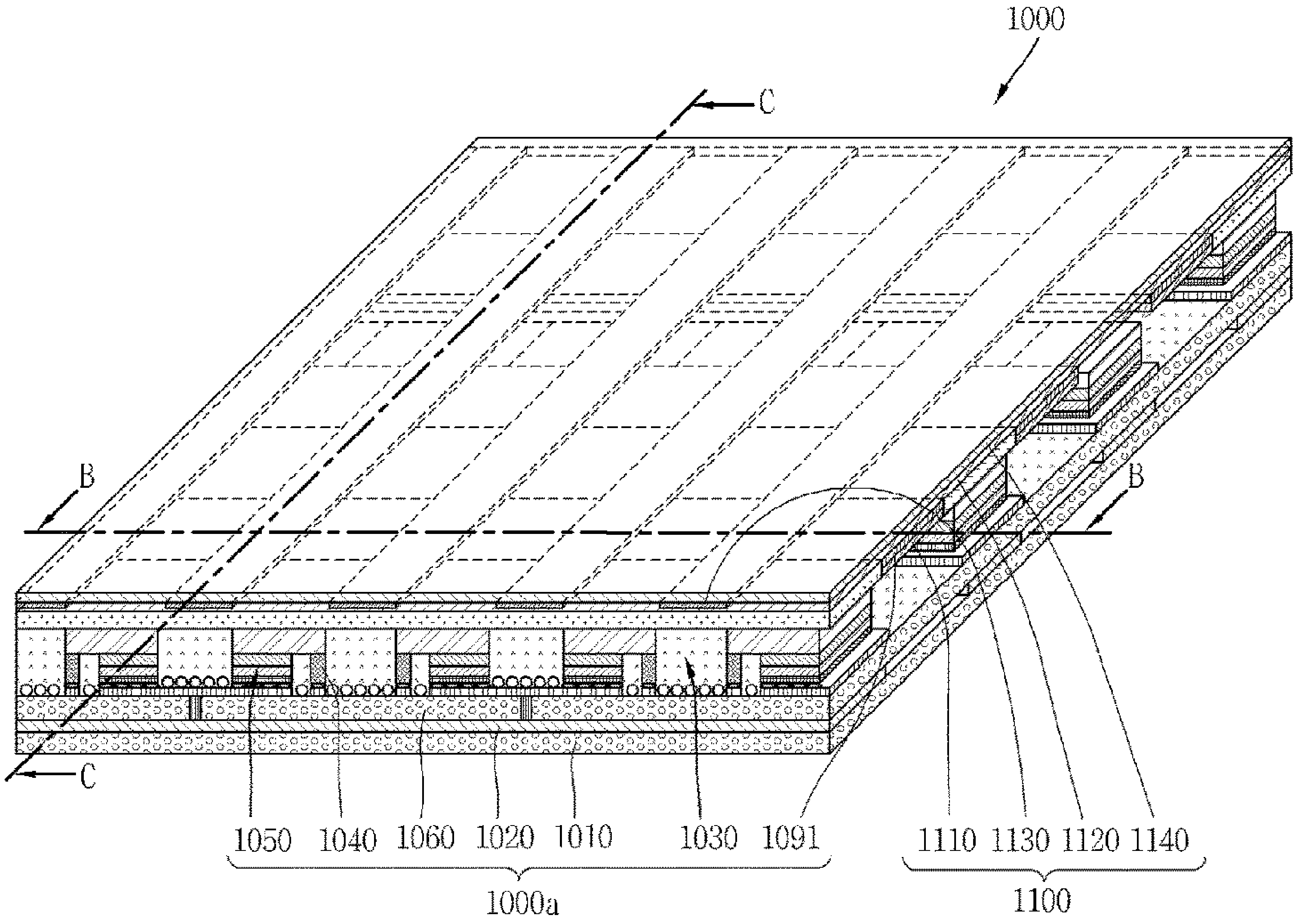
[Fig. 9]



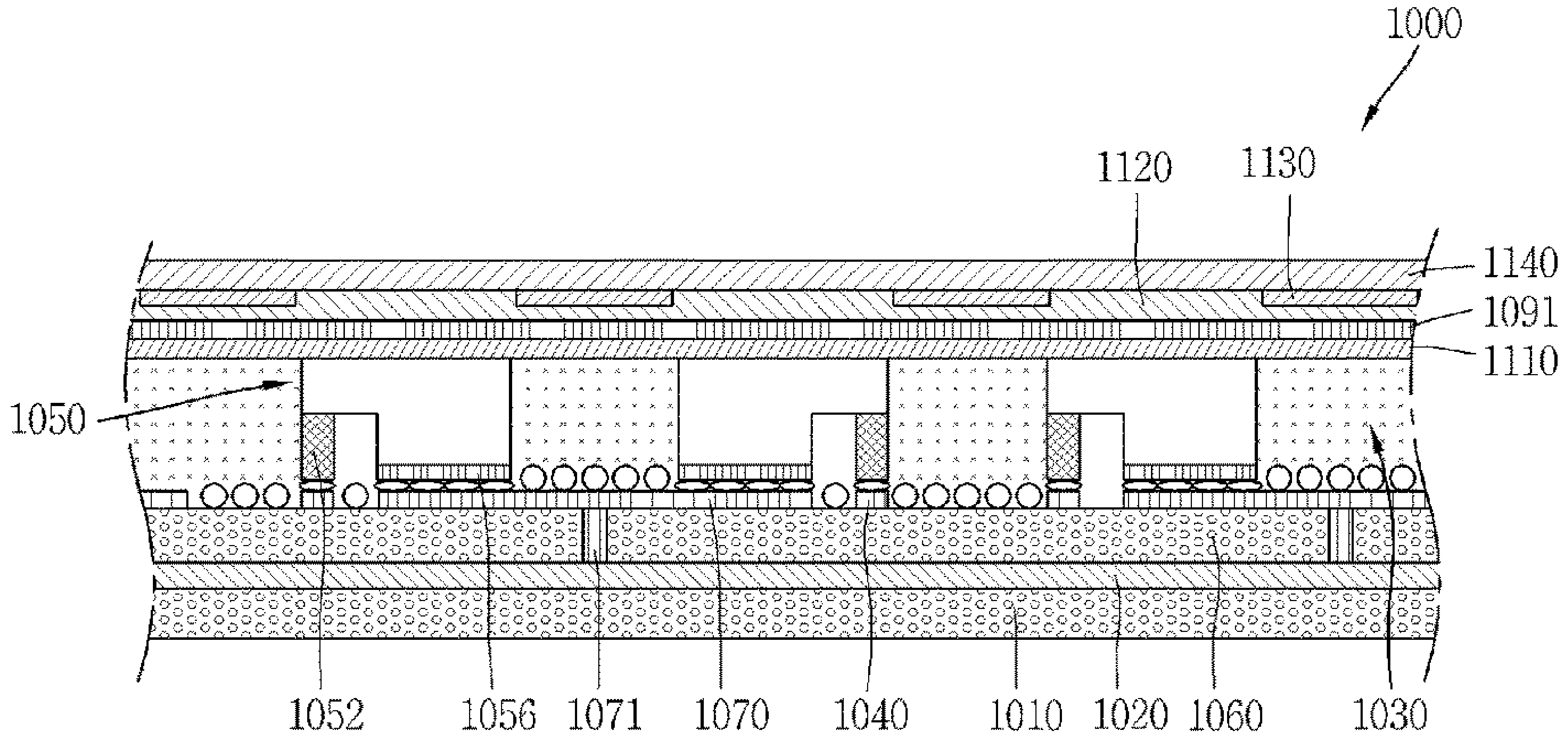
[Fig. 10]



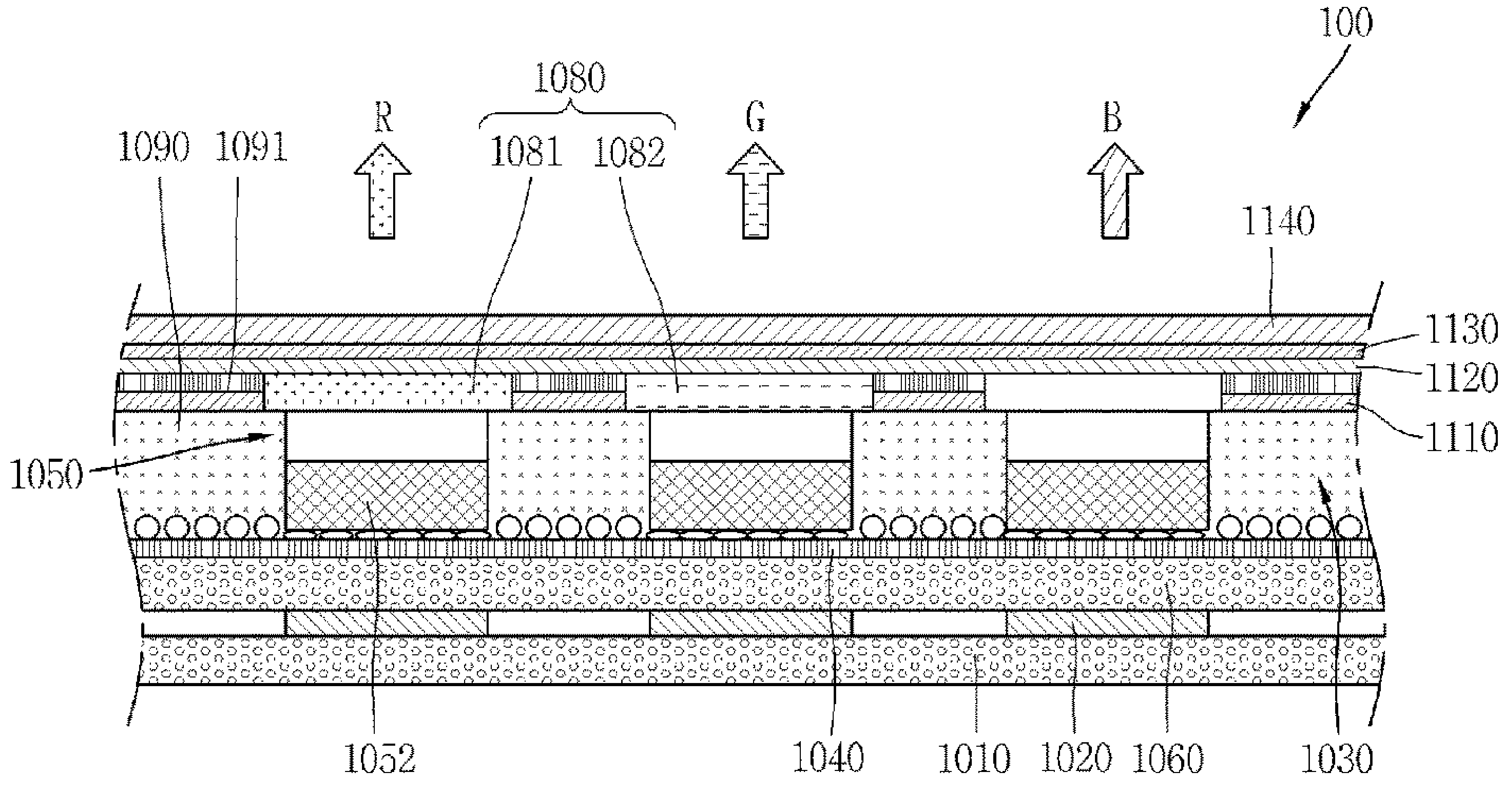
[Fig. 11]



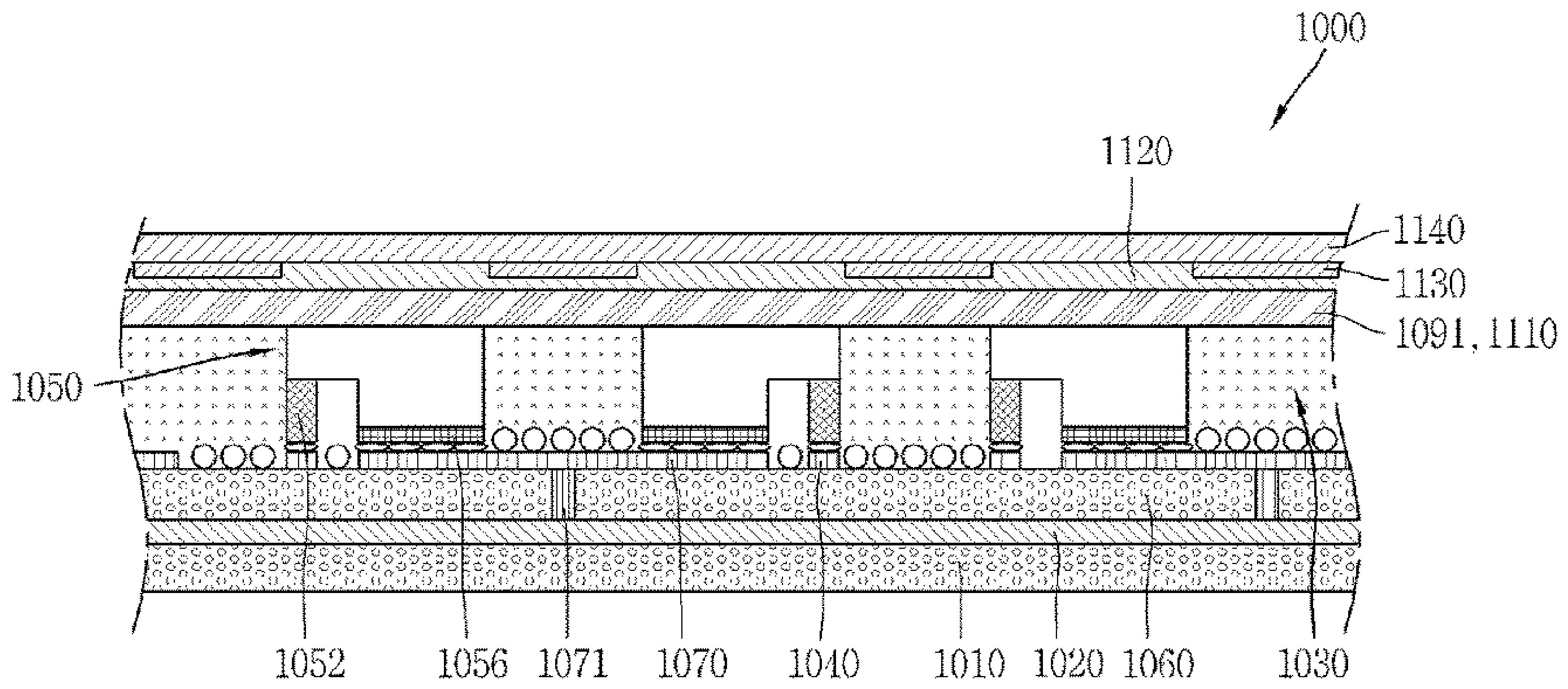
[Fig. 12a]



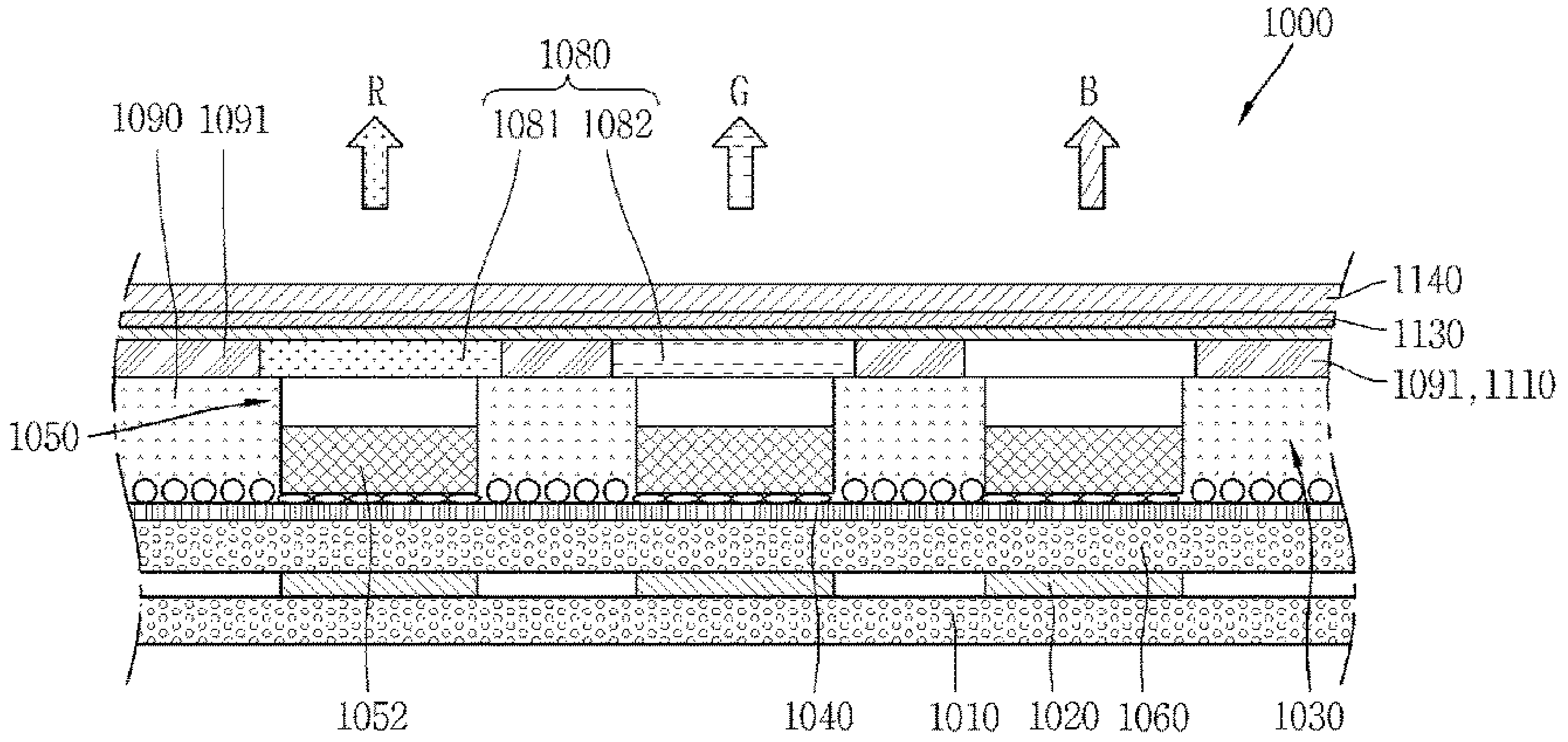
[Fig. 12b]



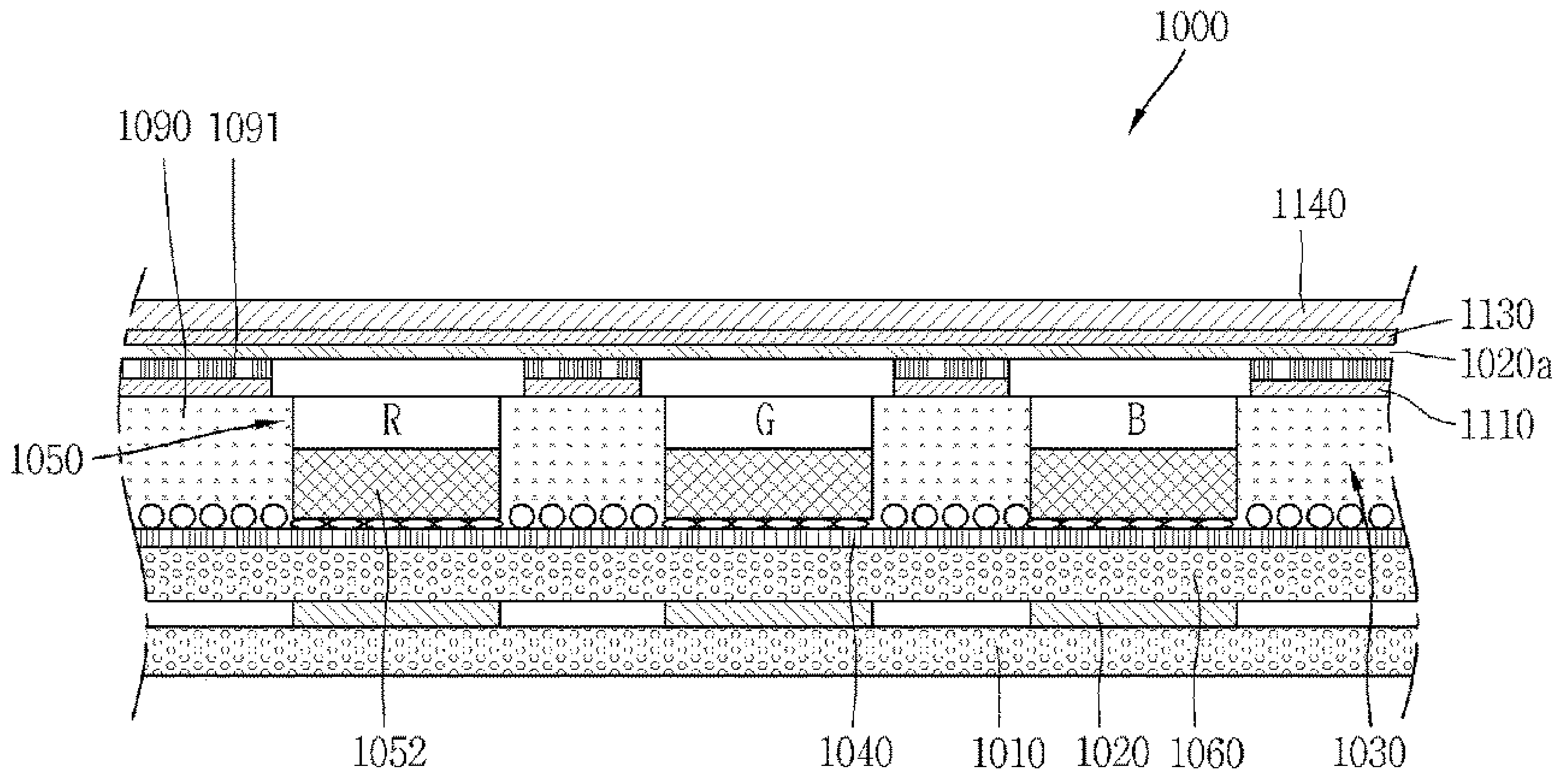
[Fig. 13a]



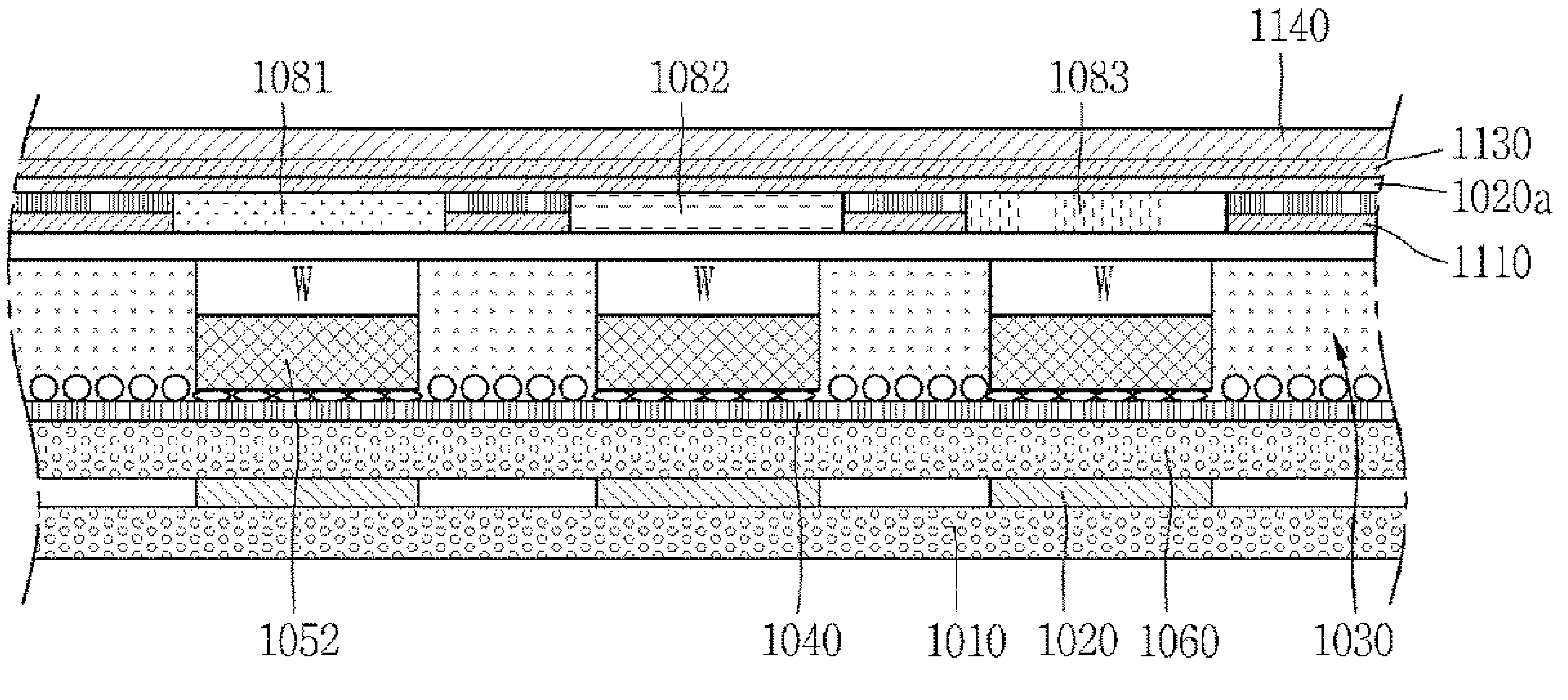
[Fig. 13b]



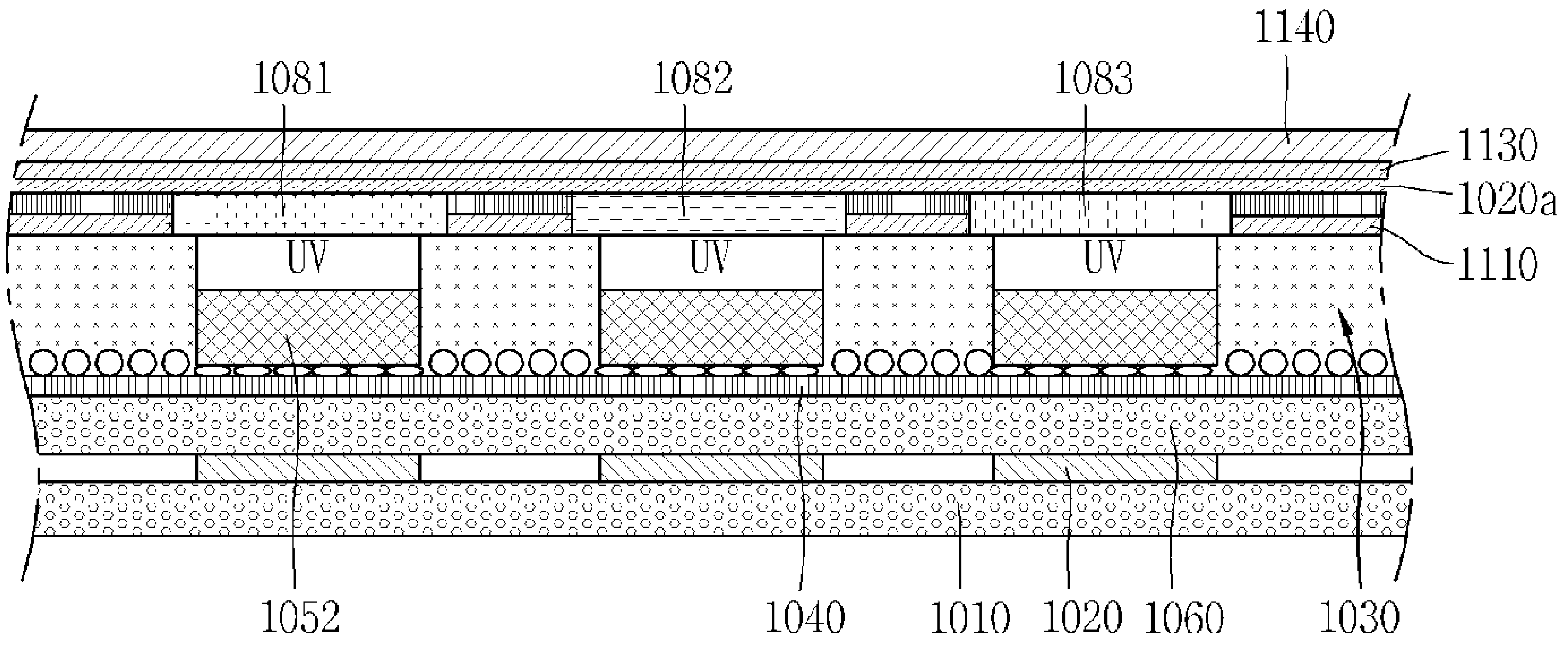
[Fig. 14a]



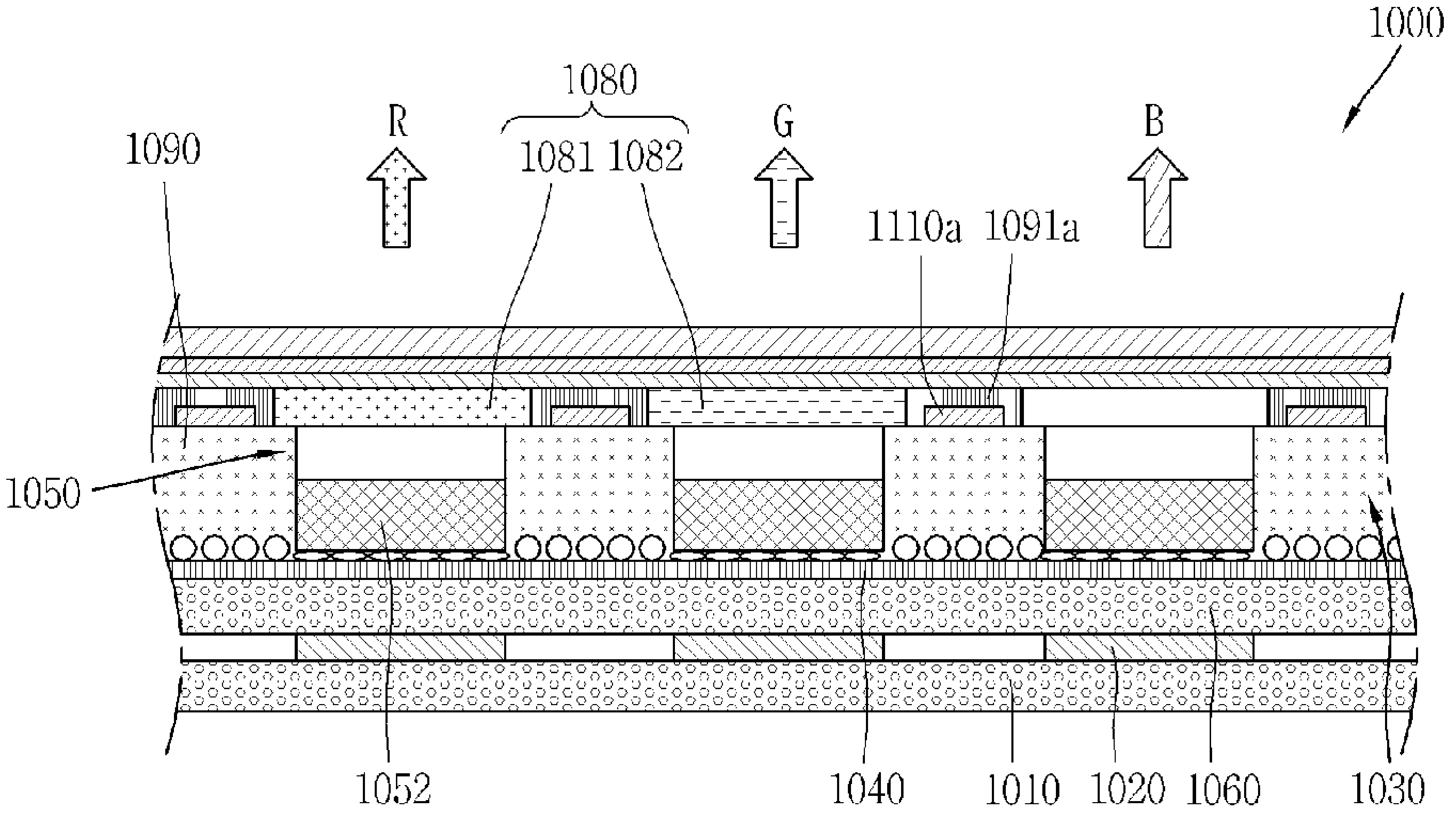
[Fig. 14b]



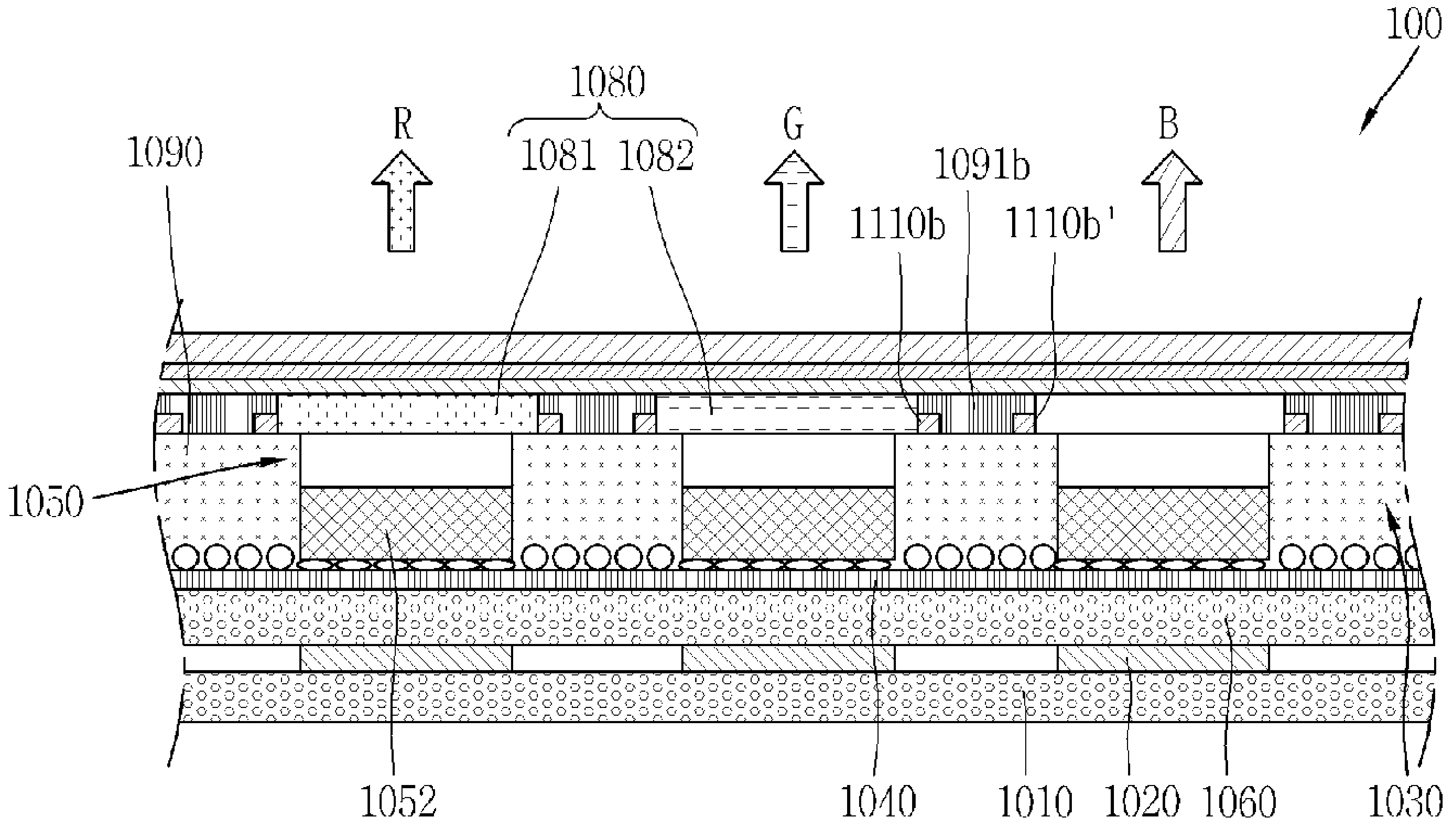
[Fig. 14c]



[Fig. 15a]



[Fig. 15b]



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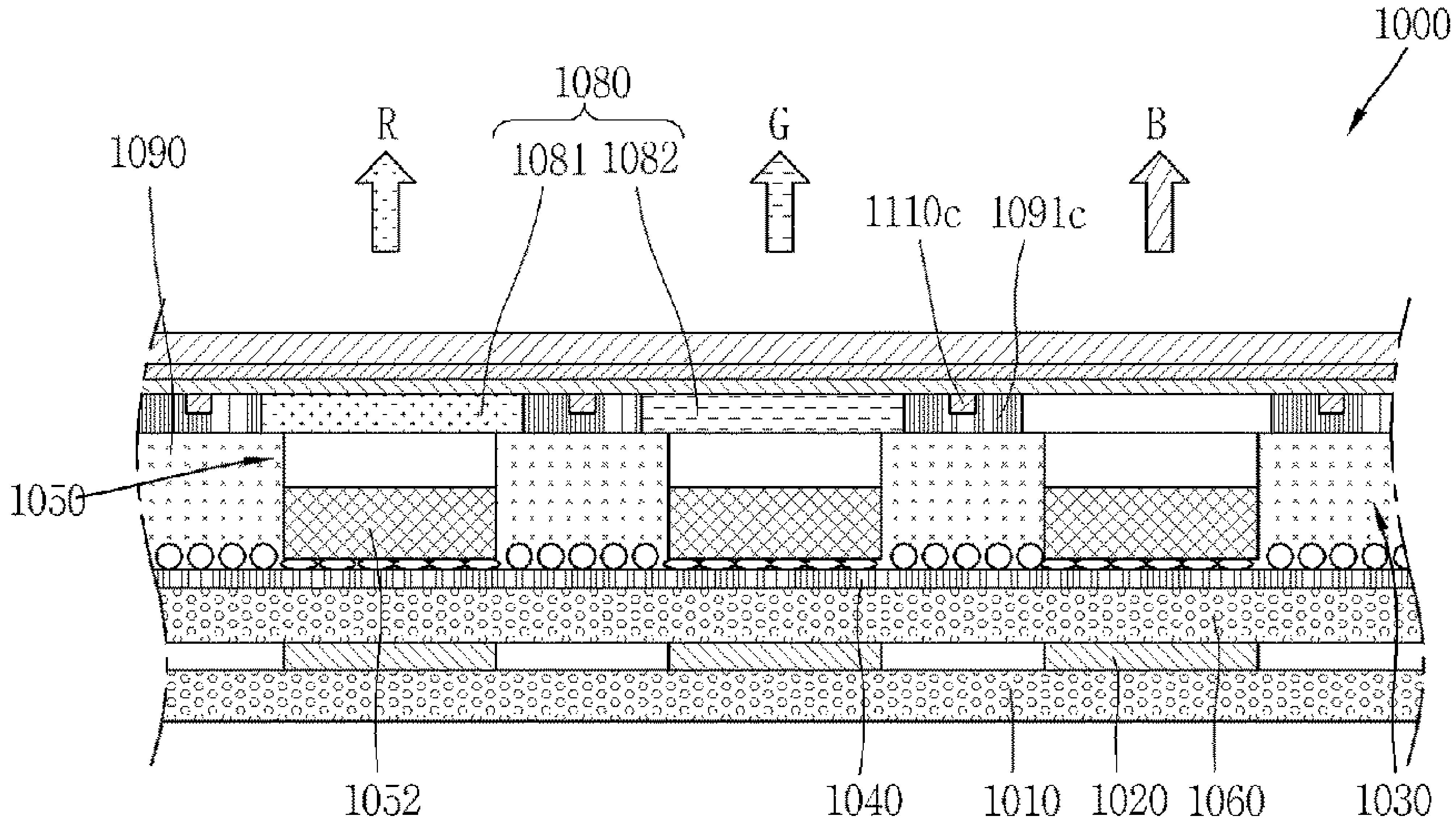
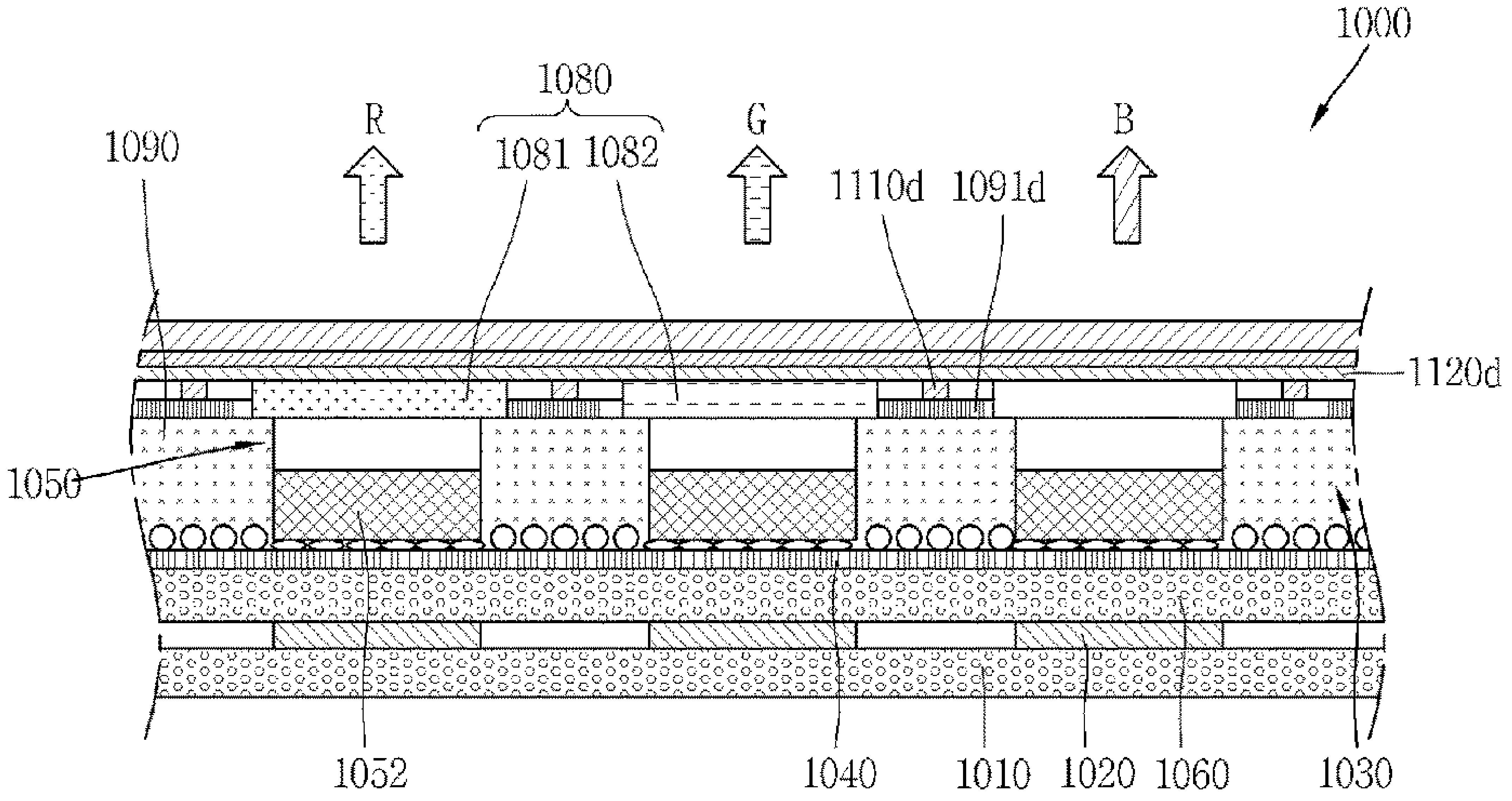
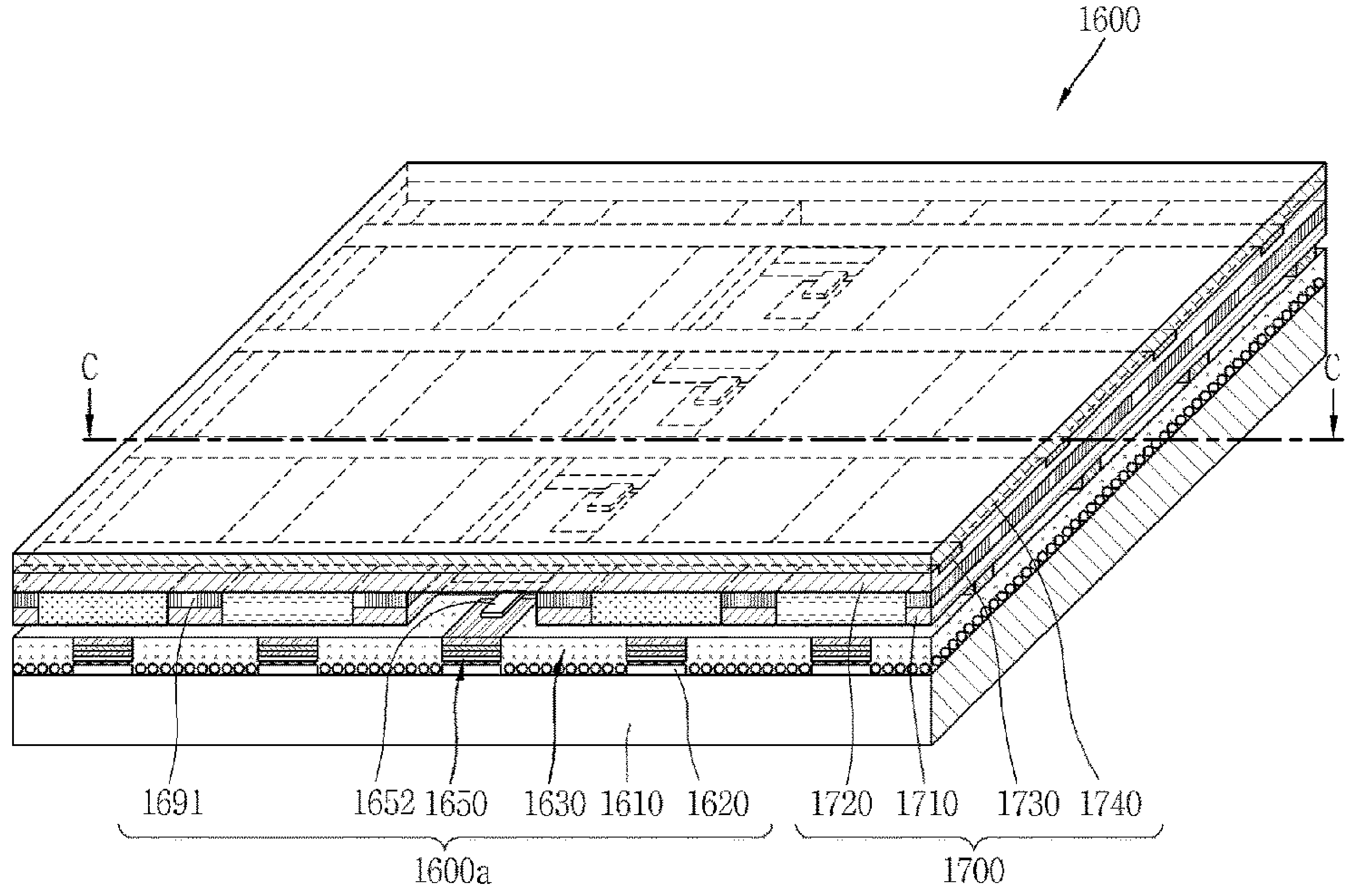


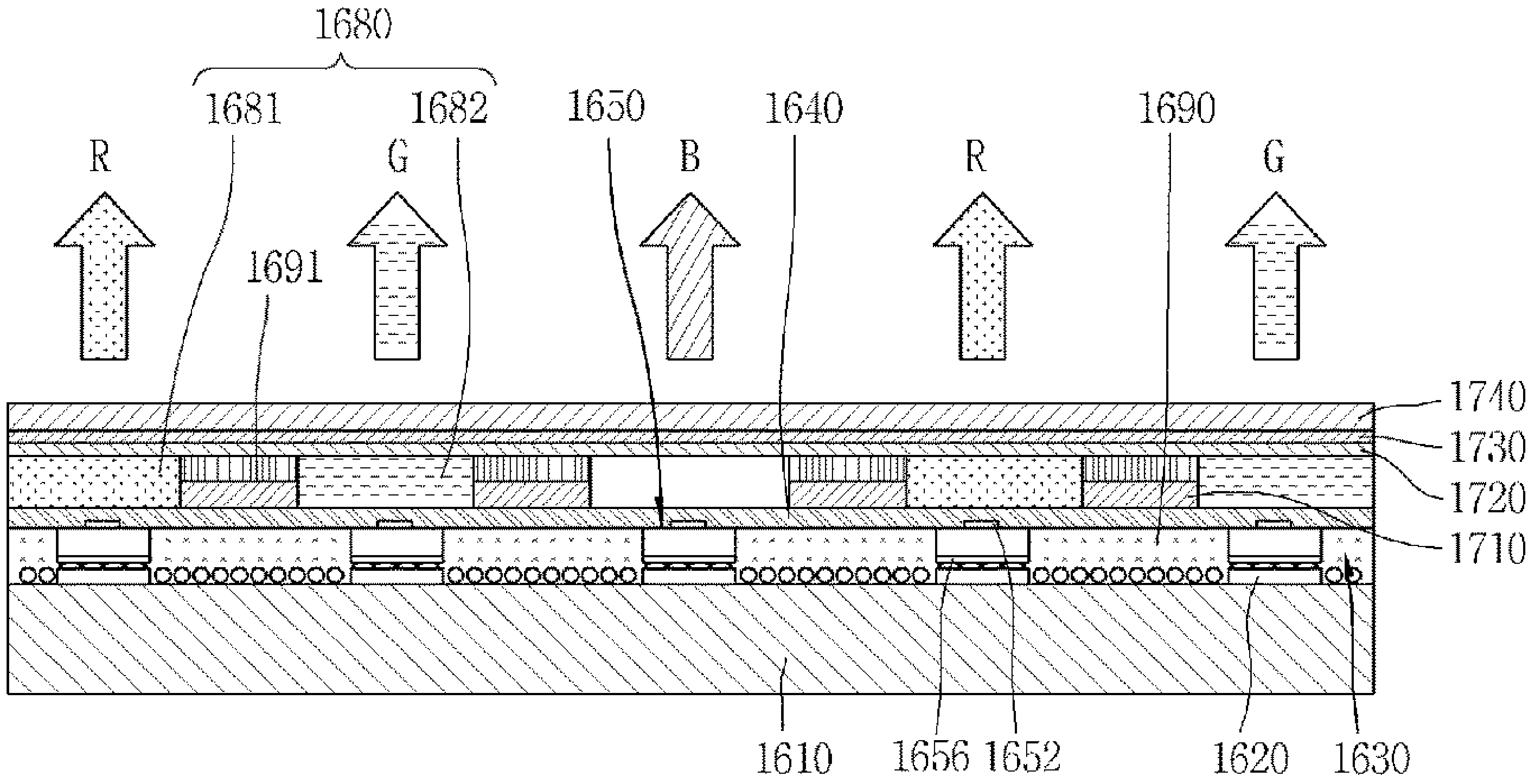
[Fig. 15d]



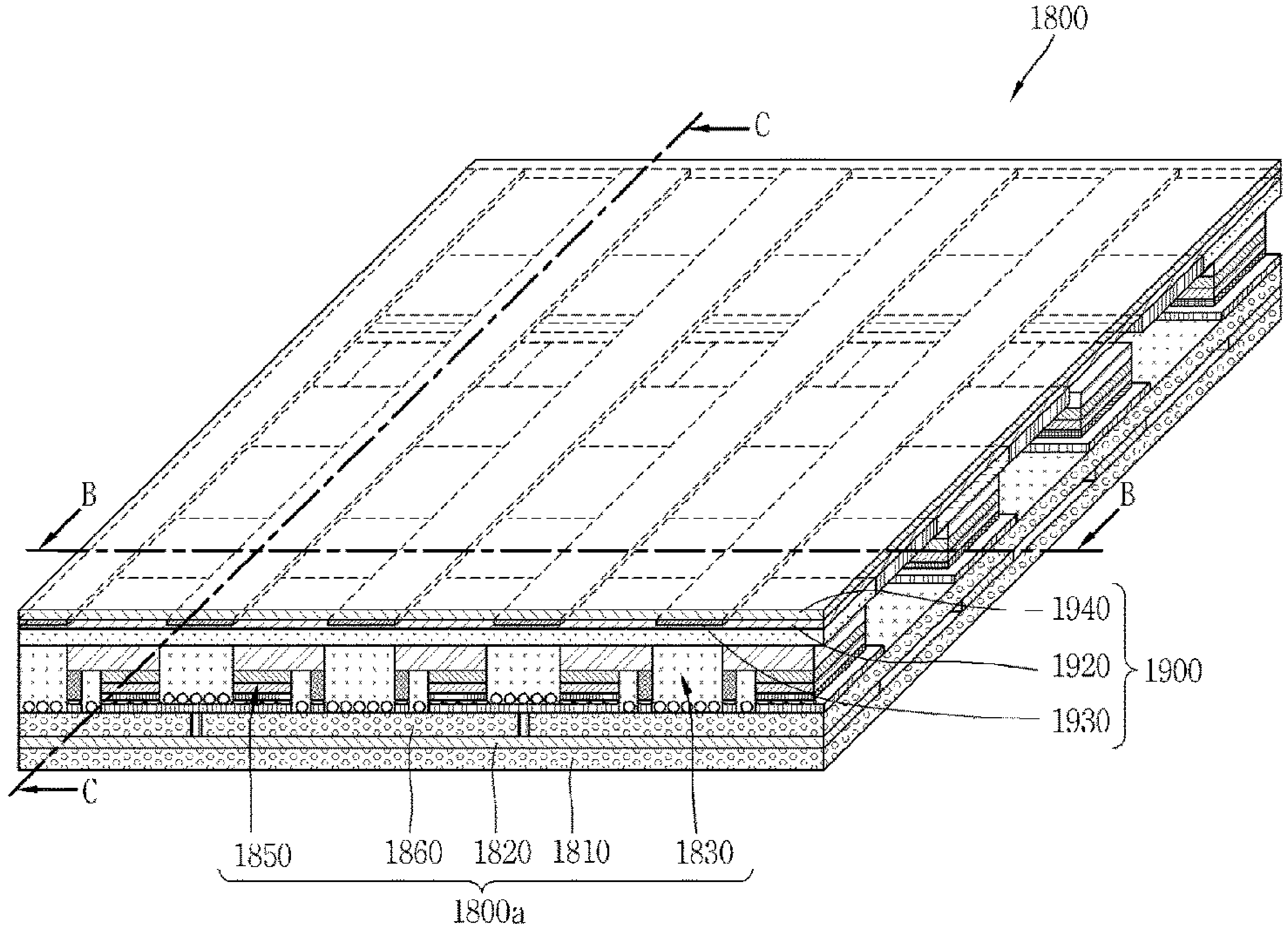
[Fig. 16]



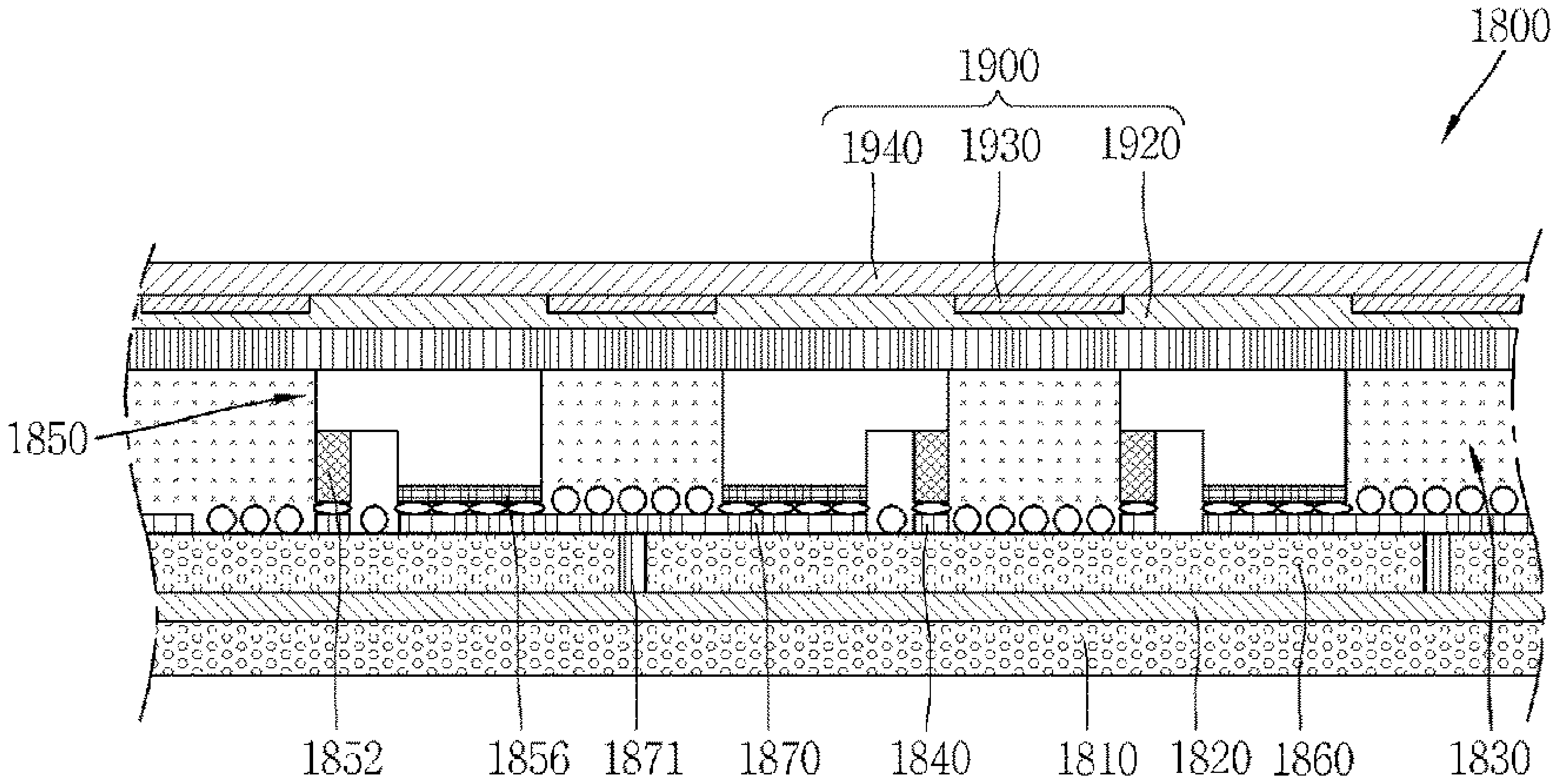
[Fig. 17]



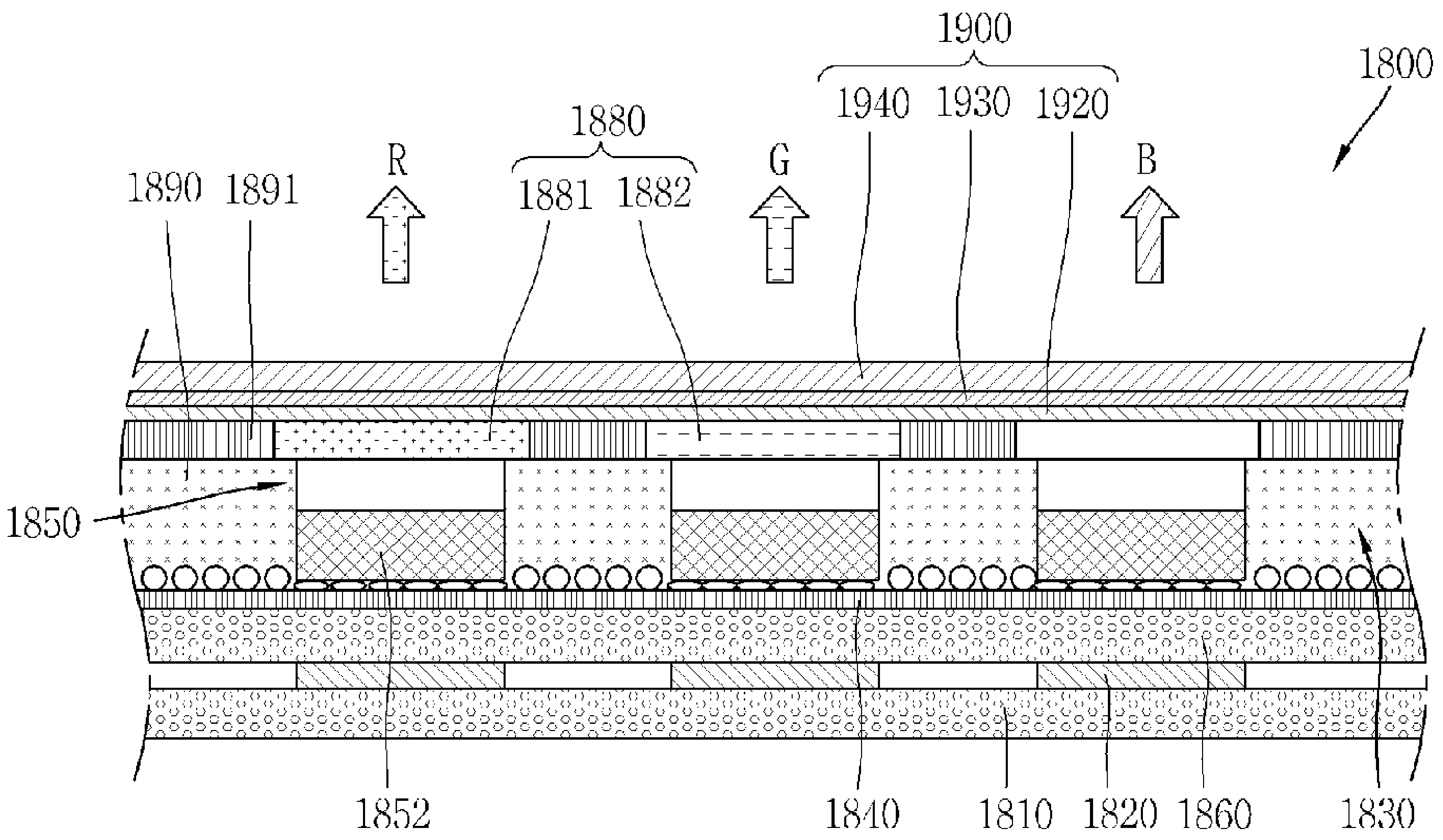
[Fig. 18]



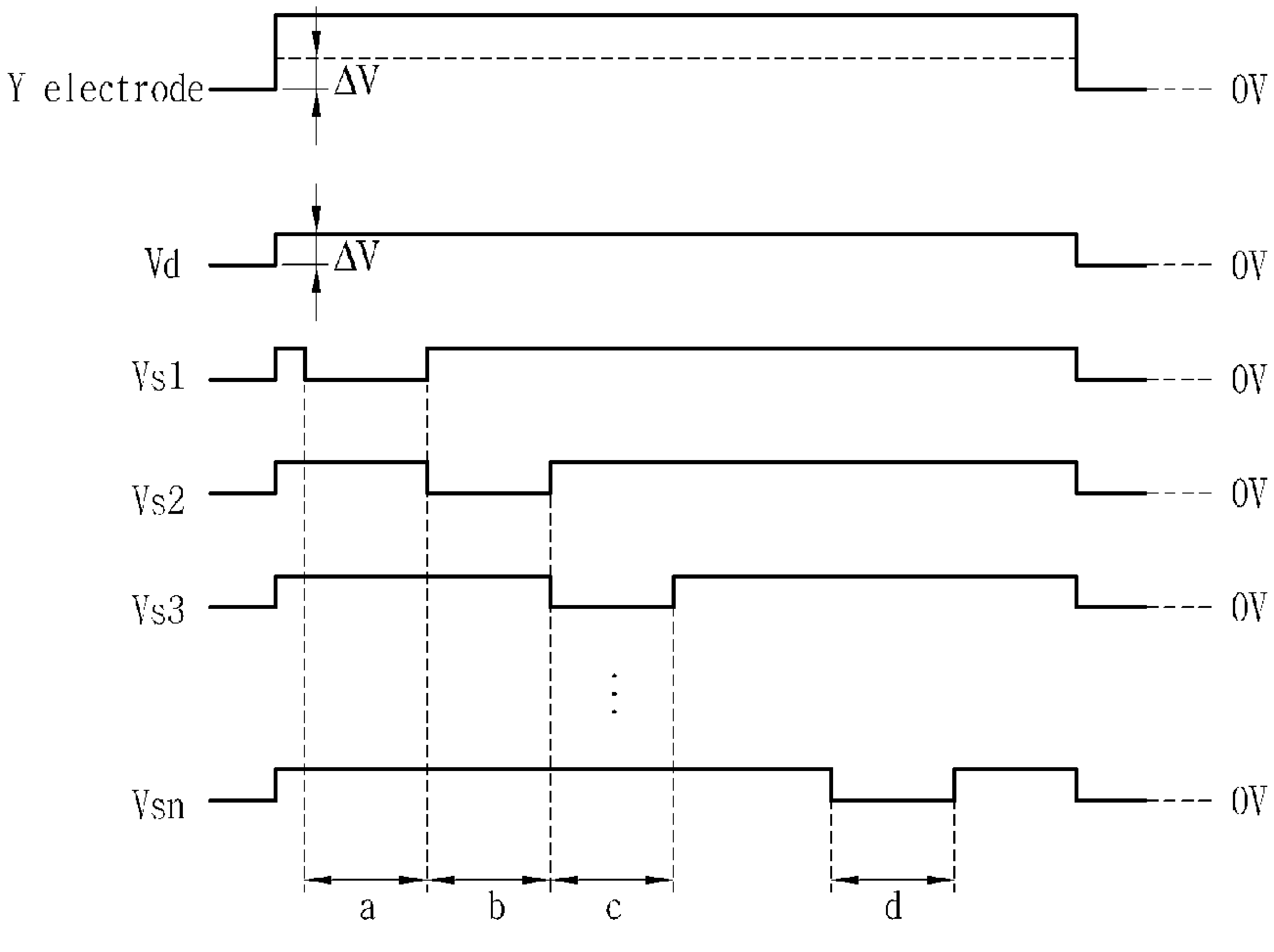
[Fig. 19a]



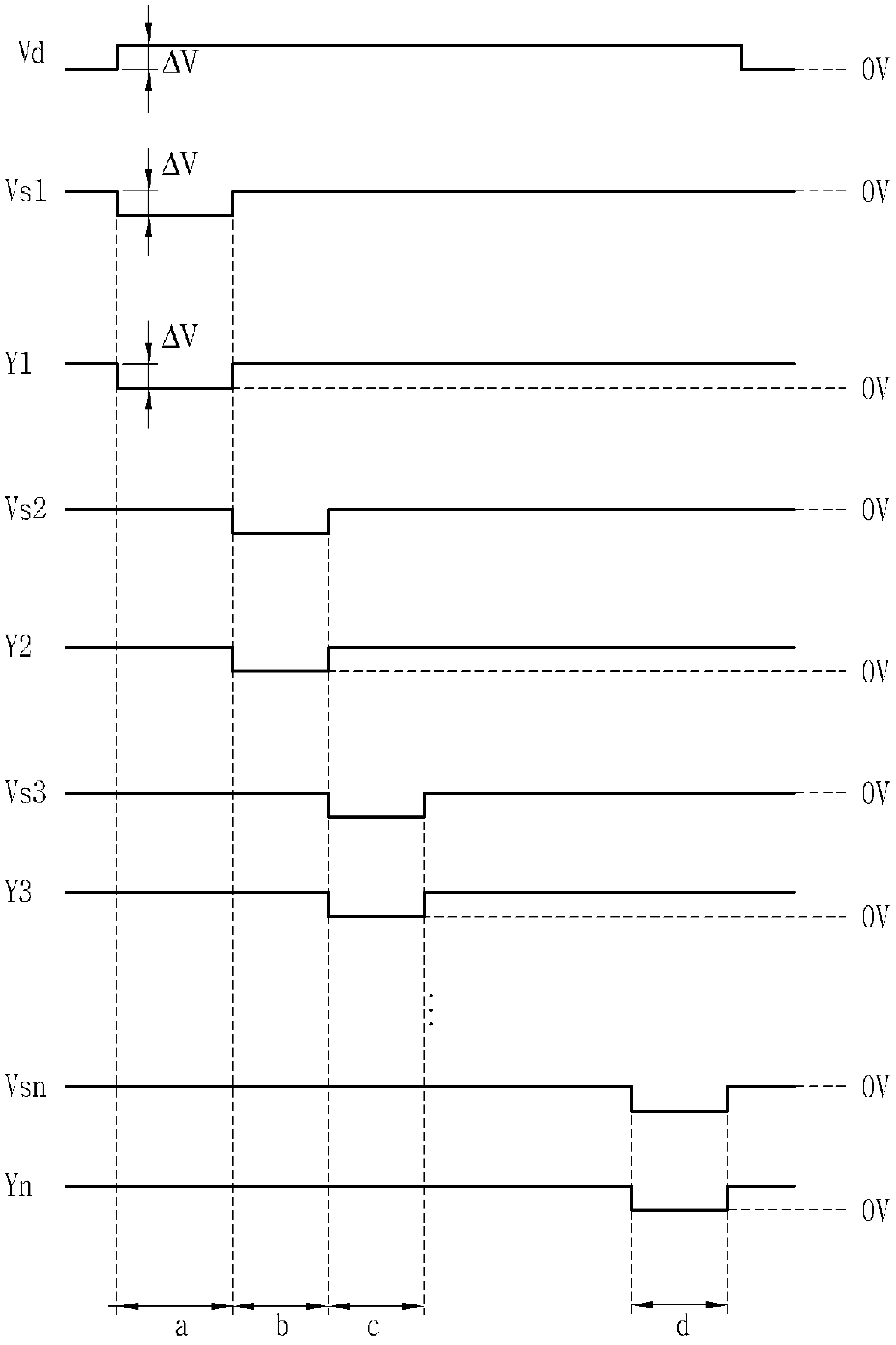
[Fig. 19b]



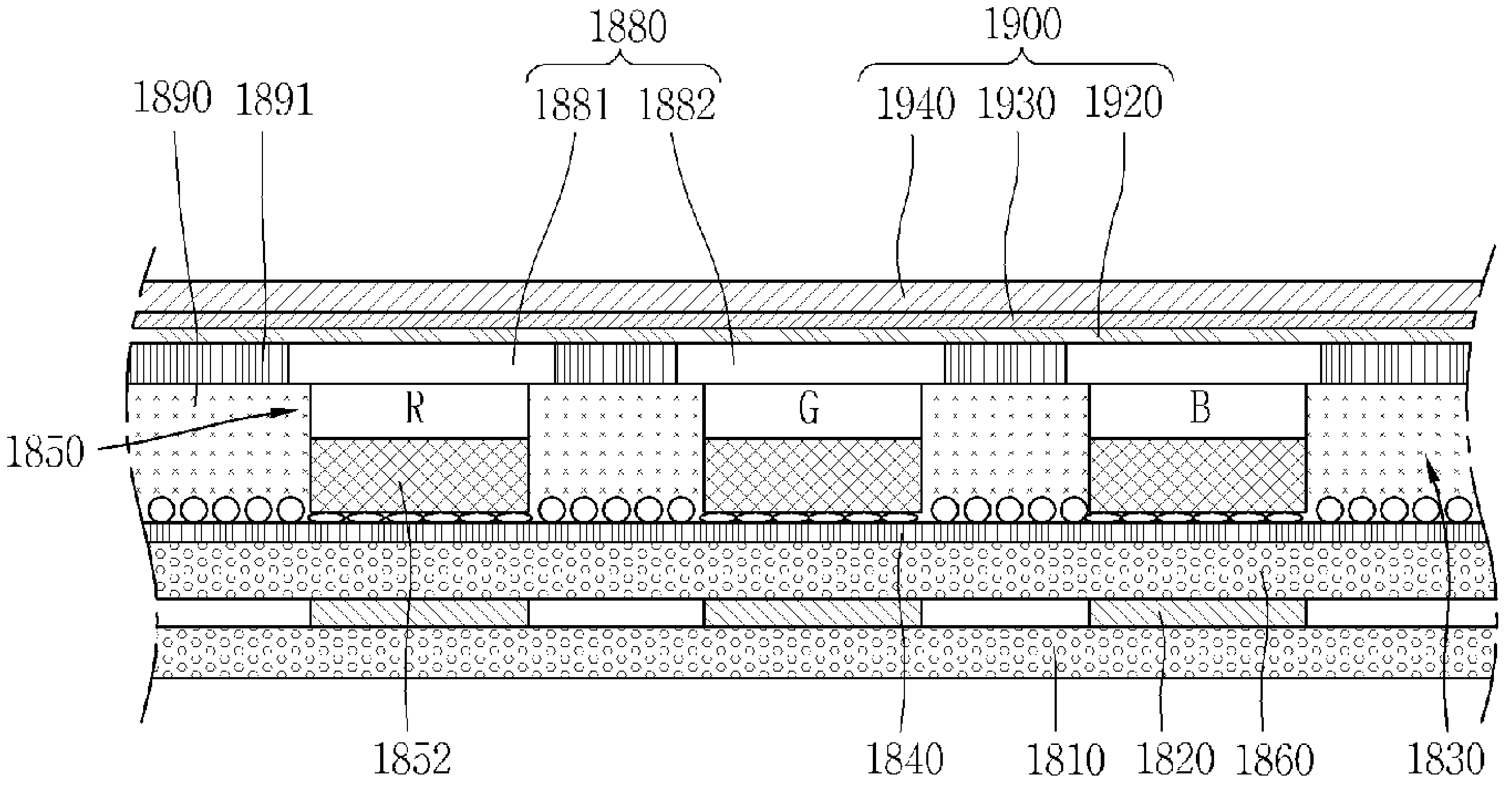
[Fig. 20]



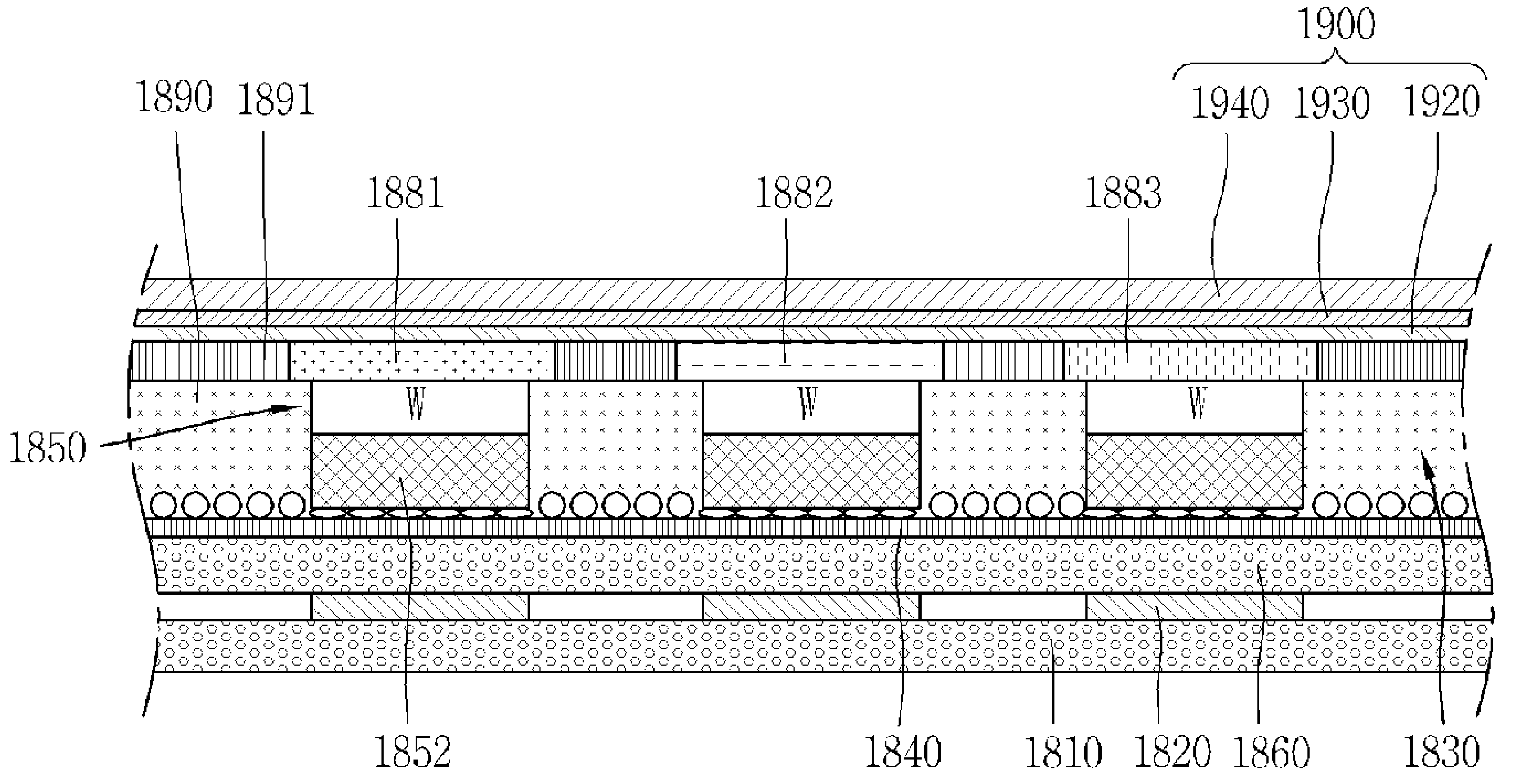
[Fig. 21]



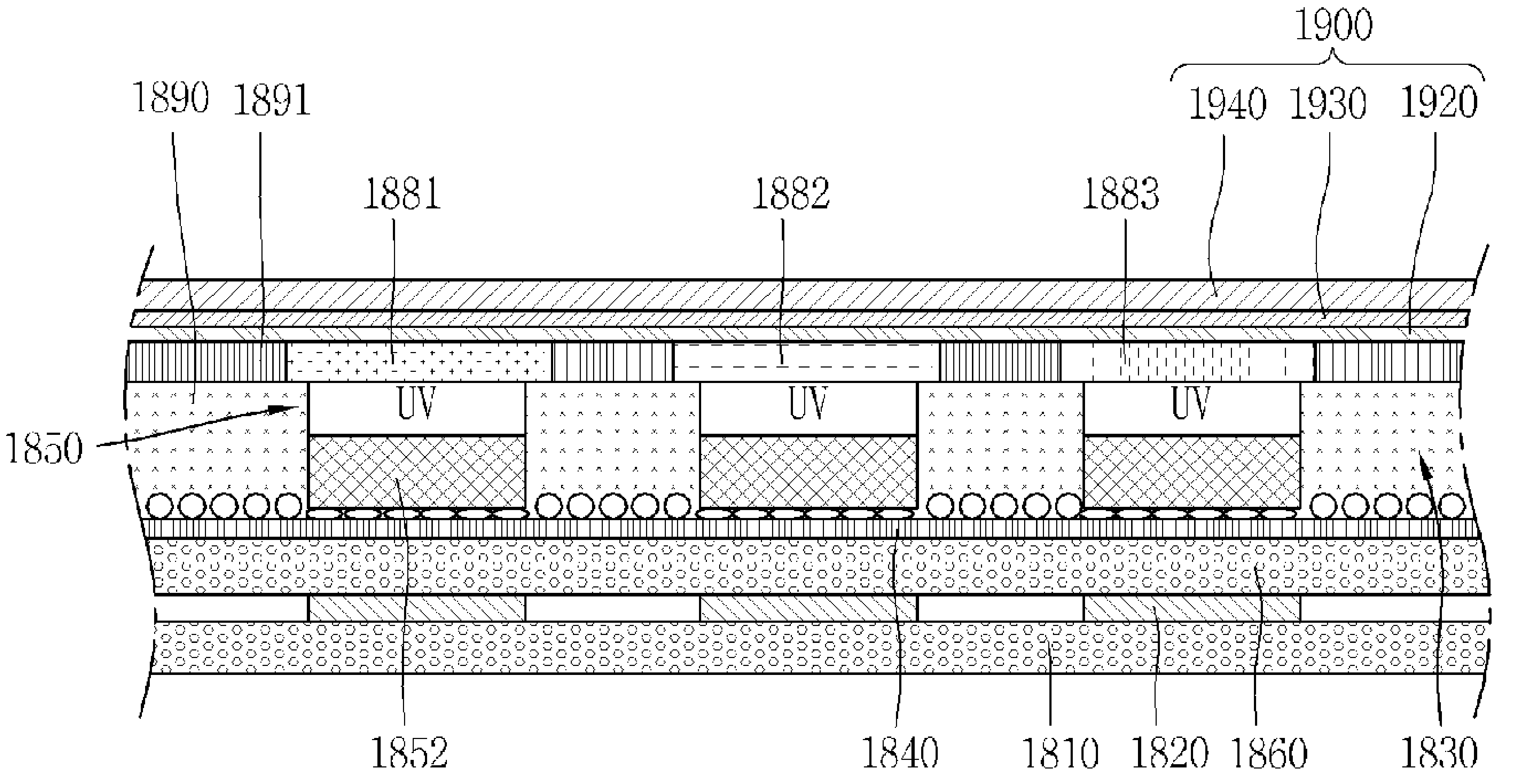
[Fig. 22a]



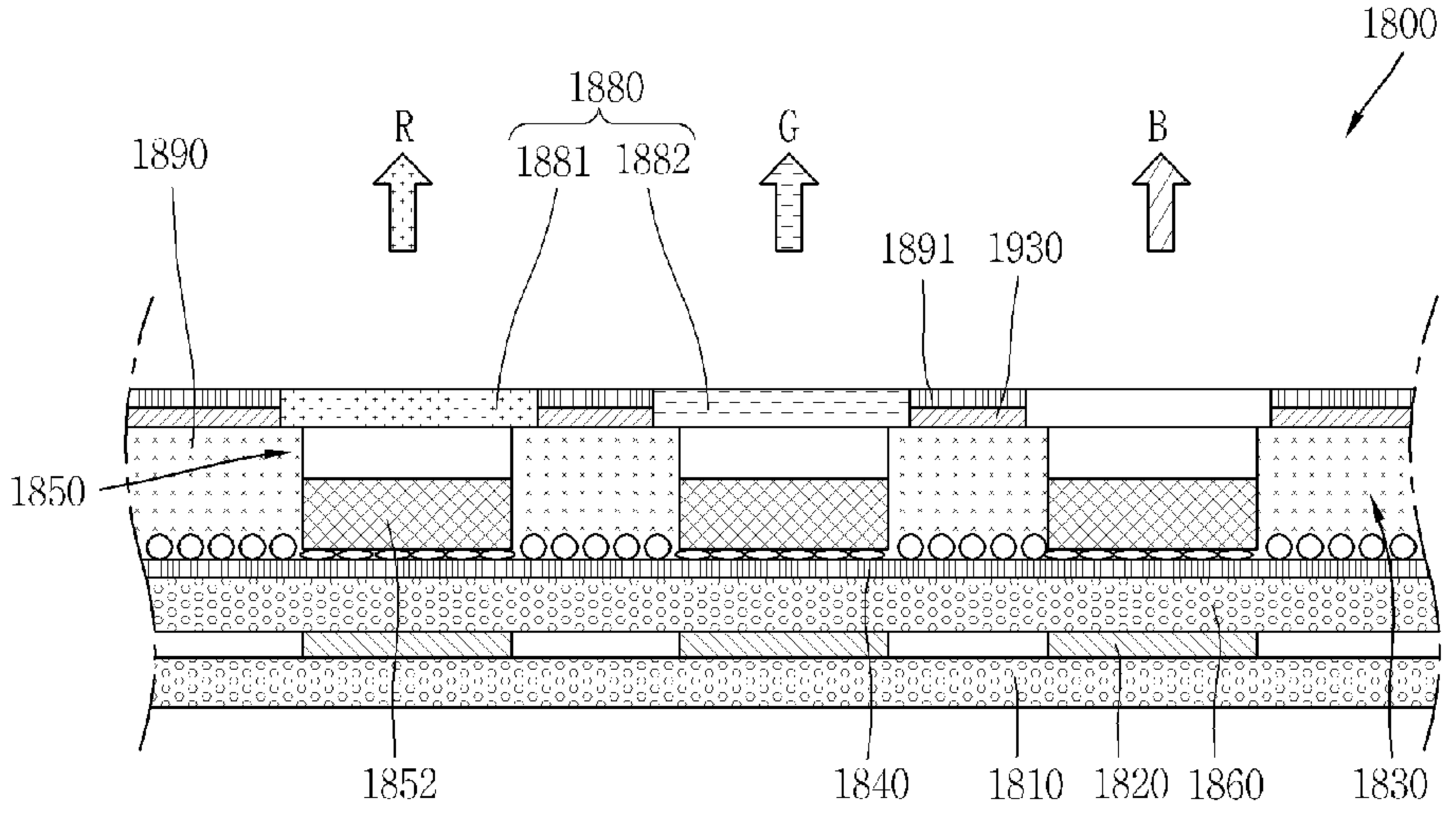
[Fig. 22b]



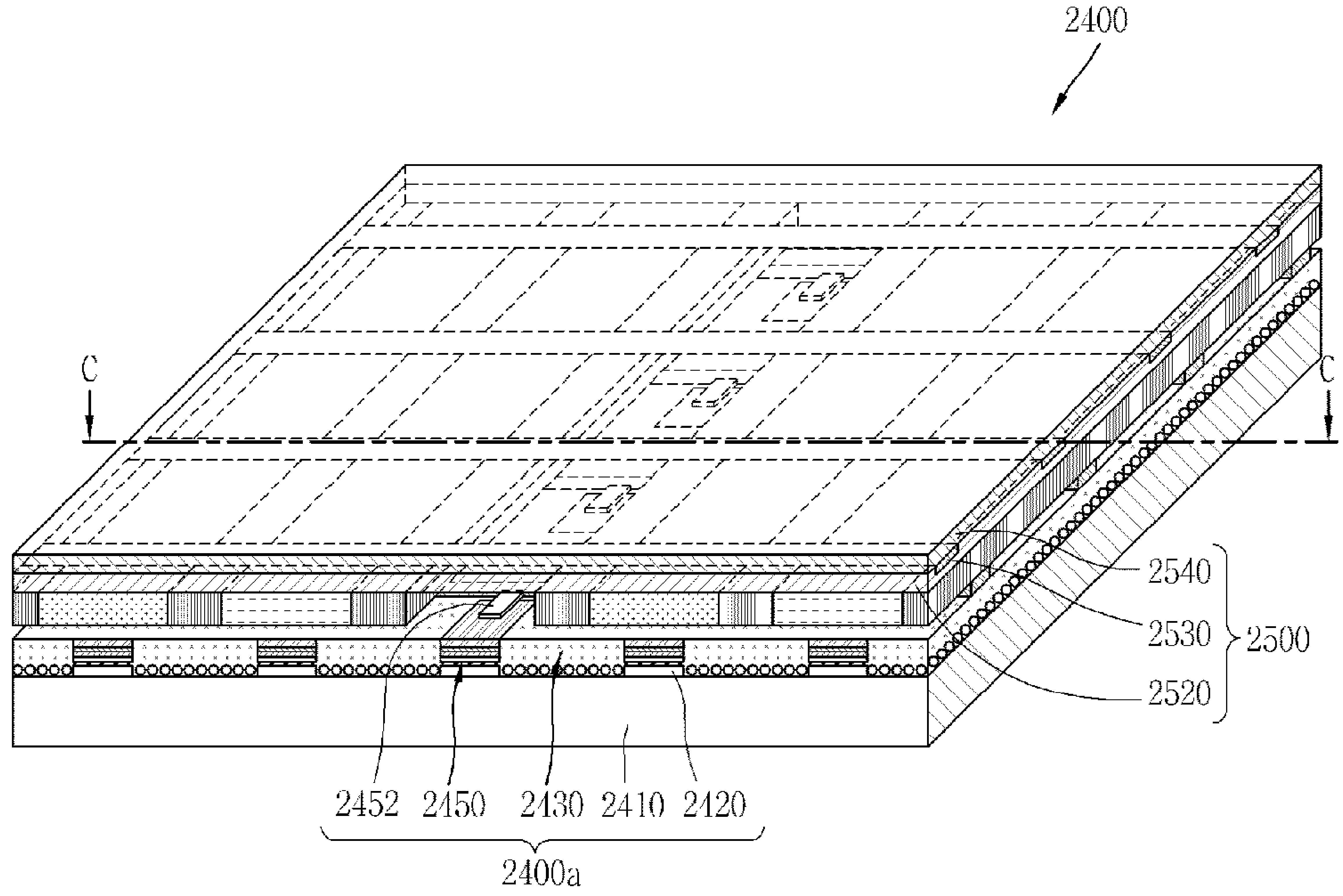
[Fig. 22c]



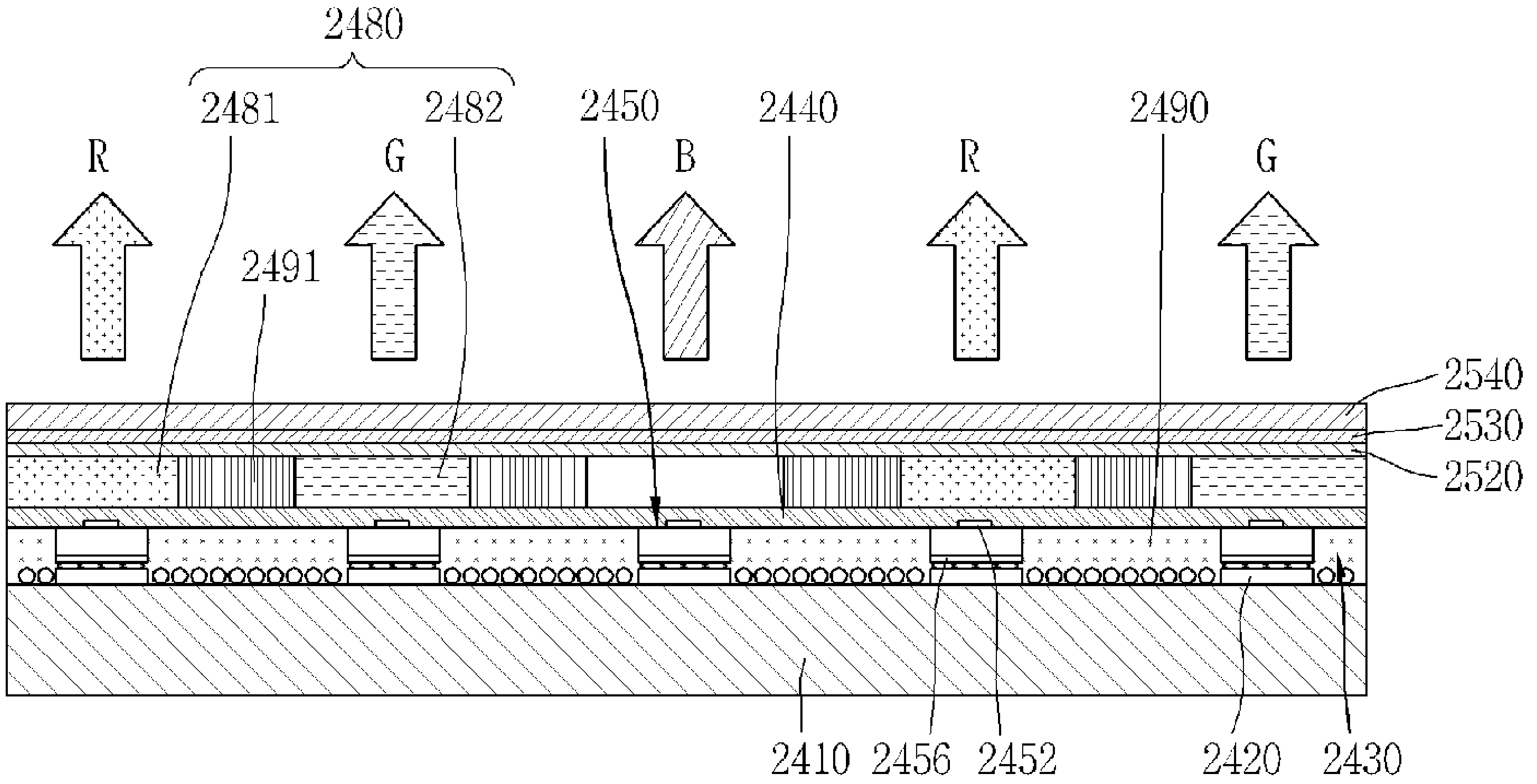
[Fig. 23]



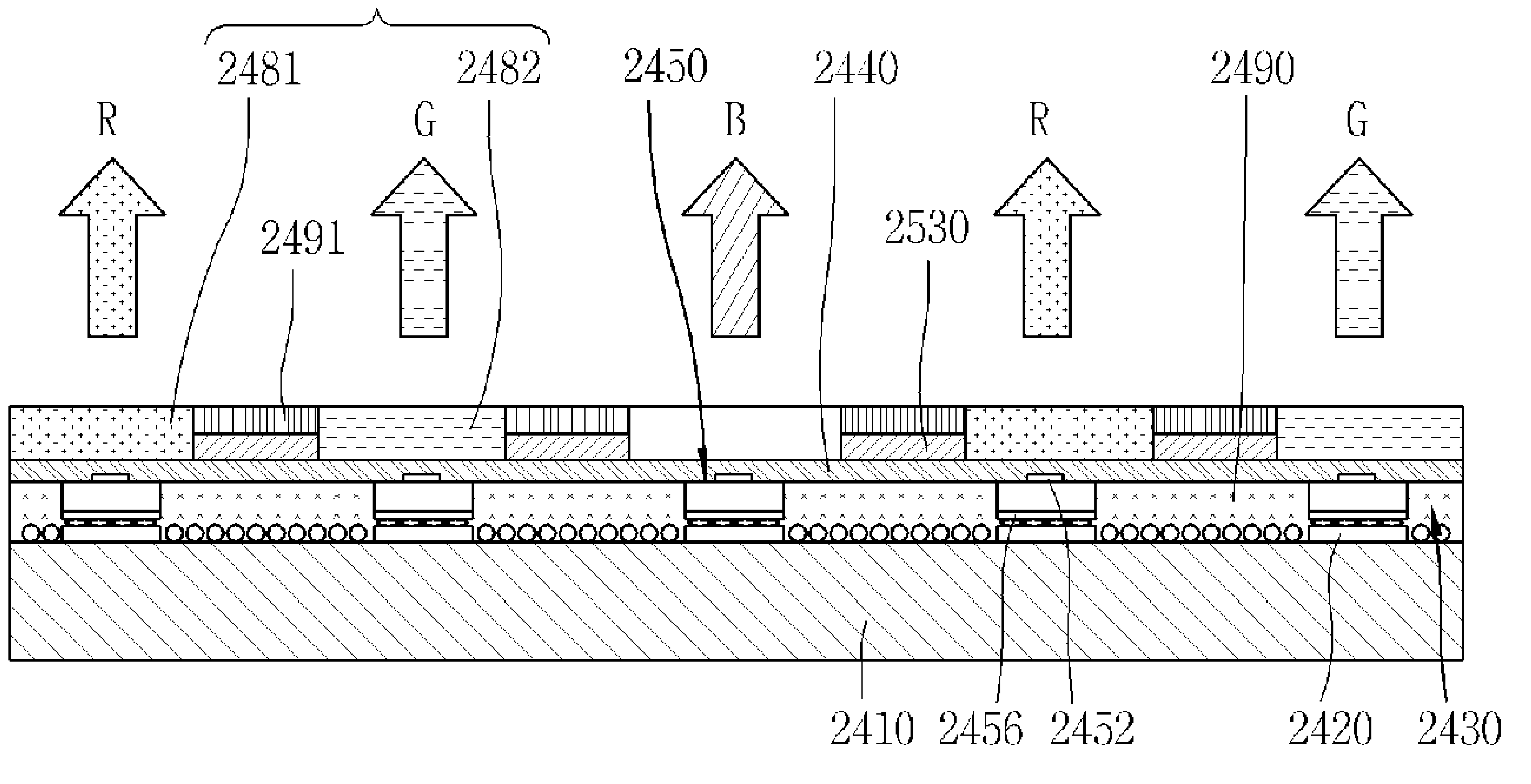
[Fig. 24]



[Fig. 25]



[Fig. 26]



DISPLAY APPARATUS USING SEMICONDUCTOR LIGHT EMITTING DEVICE

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is the National Stage filing under 35 U.S.C. 371 of International Application No. PCT/KR2014/010312, filed on Oct. 30, 2014, which claims the benefit of earlier filing date and right of priority to Korean Application No. 10-2013-0140036, filed on Nov. 18, 2013, the contents of which are all incorporated by reference herein in their entirety.

TECHNICAL FIELD

The present disclosure relates to a display apparatus, and particularly, to a display apparatus using a semiconductor light emitting device.

BACKGROUND ART

Recently, display apparatuses having excellent characteristics such as thin film characteristics, flexibility, and the like, have been developed in display technical fields. Currently commercialized major displays are represented by liquid crystal displays (LCDs) and active matrix organic light emitting diodes (OLEDs).

LCDs have a problem in that a response time is not fast and flexibility is difficult to implement, and AMOLEDs involve weak points in that a lifespan is short, a production yield is not good, and flexibility is weak.

Meanwhile, light emitting diodes (LEDs) are semiconductor light emitting devices well known to convert a current into light. Since red LEDs using a GaAsP compound semiconductor was commercialized in 1962, red LEDs have been used as light sources for displaying images of electronic devices including information communication devices, together with GaP:N-based green LEDs. Thus, a scheme of solving the above problem by implementing a flexible display using the semiconductor light emitting device may be proposed.

Also, such a display apparatus may have a touch sensor, and a structure of a touch sensor capable of reducing a thickness of a display apparatus may be considered.

DISCLOSURE OF INVENTION

Technical Problem

Therefore, an aspect of the detailed description is to provide a new, flexible display apparatus different from a related art.

Another aspect of the detailed description is to provide a structure of a touch sensor enabling reduction of a thickness of a display apparatus.

Solution to Problem

To achieve these and other advantages and in accordance with the purpose of this specification, as embodied and broadly described herein, a display apparatus including a touch sensor unit and a display unit controlled based on a touch input sensed through the touch sensor unit, wherein the display unit includes: a conductive bonding layer; and a plurality of semiconductor light emitting devices combined

with the conductive bonding layer and arranged to form a plurality of rows, and the touch sensor unit includes: an X electrode disposed between the plurality of rows of the plurality of semiconductor light emitting devices in the display unit; and an Y electrode configured to be combined with the X electrode to sense a touch input.

In an exemplary embodiment of the present disclosure, the display apparatus may further include: a black matrix disposed to cover the X electrode between the plurality of semiconductor light emitting devices.

In an exemplary embodiment of the present disclosure, phosphor layers may be formed on one surfaces of the plurality of semiconductor light emitting devices, and the black matrix and the X electrode may be positioned between the phosphor layers, respectively.

In an exemplary embodiment of the present disclosure, the X electrode may be disposed between the conductive bonding layer and the black matrix.

In an exemplary embodiment of the present disclosure, the X electrode and the black matrix may be formed of materials having different resistance values, respectively.

In an exemplary embodiment of the present disclosure, the X electrode may be formed as being black to alleviate reflection between the phosphor layers provided in the display unit.

In an exemplary embodiment of the present disclosure, the X electrode may be formed as a single layer between the phosphor layers.

In an exemplary embodiment of the present disclosure, the X electrode may be disposed inside the display unit, the Y electrode may be formed in an electrode film formed of a light-transmissive material allowing light emitted from the plurality of semiconductor light emitting devices to be transmitted therethrough, and the electrode film may be disposed to overlap the plurality of semiconductor light emitting devices outside the display unit.

In an exemplary embodiment of the present disclosure, a light-transmissive member may be disposed between the electrode film and the plurality of semiconductor light emitting devices to space the X and Y electrodes and allow light from the semiconductor light emitting devices to be transmitted therethrough.

In an exemplary embodiment of the present disclosure, the display unit may include: a plurality of horizontal electrode lines electrically connected to the plurality of semiconductor light emitting devices; and a plurality of vertical electrode lines arranged in a direction crossing the plurality of horizontal electrode lines and disposed to be parallel to the X electrode.

In an exemplary embodiment of the present disclosure, the plurality of horizontal electrode lines and the plurality of vertical electrode lines may be formed on a wiring board covered by the conductive bonding layer.

In an exemplary embodiment of the present disclosure, the display unit may include a vertical electrode and a horizontal electrode electrically connected to the plurality of semiconductor light emitting devices and arranged in mutually crossing directions, and any one of the vertical electrode and the horizontal electrode may have a potential difference from the X electrode such that the any one of the vertical electrode and the horizontal electrode becomes a Y electrode of the touch sensor unit.

In an exemplary embodiment of the present disclosure, the touch sensor unit may sense a touch input through a signal transmission line formed between any one of the vertical electrode and the horizontal electrode and the X electrode.

To achieve these and other advantages and in accordance with the purpose of this specification, as embodied and broadly described herein, a display apparatus including: first and second electrodes; a conductive bonding layer electrically connected to at least one of the first and second electrodes; a semiconductor light emitting device combined with the conductive bonding layer; a third electrode configured to form a potential difference with any one of the first and second electrodes to sense a touch input; and a controller configured to control the semiconductor light emitting device through a first signal transmission line formed by the first and second electrodes and process a touch input sensed through a second signal transmission line formed by any one of the first and second electrodes and the third electrode.

In an exemplary embodiment of the present disclosure, a driving signal of the semiconductor light emitting device may be generated due to a first potential difference formed between the first and second electrodes, and a second potential difference formed between the any one of the first and second electrodes and the third electrode to sense a touch input may be greater than the first potential difference.

In an exemplary embodiment of the present disclosure, an influence of the generated first potential difference on the second potential difference may be processed as noise in sensing the touch input.

In an exemplary embodiment of the present disclosure, magnitudes of voltages applied to any one of the first and second electrode and the other may be smaller than a magnitude of a voltage applied to the third electrode.

In an exemplary embodiment of the present disclosure, the semiconductor light emitting device may be turned on based on a potential difference between the first and second electrodes formed as a potential of any one of the first and second electrodes is changed, and a potential of the third electrode may be changed in response to the change in the potential of any one of the first and second electrodes to maintain the potential difference for sensing a touch input.

In an exemplary embodiment of the present disclosure, the change in the potential of any one of the first and second electrodes and the change in the potential of the third electrode may be generated in the form of a pulse, respectively, and the potentials may be changed at the same point in time and with the same magnitude.

In an exemplary embodiment of the present disclosure, the third electrode may be formed on an electrode film formed of a light-transmissive material allowing light emitted from the semiconductor light emitting device to be transmitted therethrough, and the electrode film may be disposed to overlap the semiconductor light emitting device.

In an exemplary embodiment of the present disclosure, the third electrode may be disposed between a plurality of semiconductor light emitting devices arranged to form a plurality of rows and combined with any one of the first and second electrodes to sense a touch input.

According to exemplary embodiments of the present disclosure, by disposing at least one of a plurality of electrodes constituting a touch sensor in a display unit, a space occupied by the electrode may be reduced. Thus, a thinner display apparatus can be provided.

Further scope of applicability of the present application will become more apparent from the detailed description given hereinafter. However, it should be understood that the detailed description and specific examples, while indicating preferred exemplary embodiments of the invention, are given by way of illustration only, since various changes and modifications within the spirit and scope of the invention will become apparent to those skilled in the art from the detailed description.

Advantageous Effects of Invention

As described above, according to the present disclosure, by utilizing any one of the first and second electrodes of the display unit, as an electrode of the touch sensor, a thickness of the touch sensor can be reduced.

BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** is a conceptual view illustrating a display apparatus using a semiconductor light emitting device according to an exemplary embodiment of the present disclosure;

FIG. **2** is a partially enlarged view of portion 'A' of FIG. **1**;

FIGS. **3**A and **3**B are cross-sectional views taken along line B-B, and C-C of FIG. **2**;

FIG. **4** is a conceptual view illustrating a flipchip type semiconductor light emitting device of FIG. **3**A;

FIGS. **5**A through **5**C are conceptual views illustrating various configurations implementing color in relation to the flipchip type semiconductor light emitting device;

FIG. **6** includes cross-sectional views illustrating a method of manufacturing a display apparatus using a semiconductor light emitting device according to an exemplary embodiment of the present disclosure;

FIG. **7** is a perspective view illustrating a display apparatus using a semiconductor light emitting device according to another exemplary embodiment of the present disclosure;

FIG. **8** is a cross-sectional view taken along line C-C of FIG. **7**;

FIG. **9** is a conceptual view illustrating a vertical semiconductor light emitting device of FIG. **8**;

FIG. **10** is a conceptual view illustrating an example of a display apparatus including a touch sensor;

FIG. **11** is an enlarged view of portion 'A' of FIG. **10**;

FIGS. **12**A and **12**B are cross-sectional views taken along lines B-B and C-C of FIG. **11**;

FIGS. **13**A and **13**B are cross-sectional views illustrating another example in relation to a touch sensor;

FIGS. **14**A, **14**B, and **14**C are conceptual views illustrating various configurations implementing color in relation to a flipchip type semiconductor light emitting device to which the present invention is applied and various types of stacked structures for implementing touch sensors;

FIGS. **15**A, **15**B, **15**C, and **15**D are conceptual views illustrating various configurations in which electrodes of a touch sensor are disposed in a black matrix;

FIG. **16** is a perspective view illustrating a display apparatus using a semiconductor light emitting device according to another exemplary embodiment of the present disclosure;

FIG. **17** is a cross-sectional view taken along line C-C of FIG. **16**;

FIG. **18** is a perspective view illustrating a display apparatus using a semiconductor light emitting device according to another exemplary embodiment of the present disclosure;

FIGS. **19**A and **19**B are cross-sectional views taken along line B-B and C-C of FIG. **18**;

FIGS. **20** and **21** are conceptual views of signal processing illustrating driving of a semiconductor light emitting device and a touch sensor in the display apparatus of FIG. **18**;

FIGS. **22**A, **22**B, and **22**C are conceptual views illustrating various configurations implementing color in relation to a flipchip type semiconductor light emitting device to which the present invention is applied and various types of stacked structures for implementing touch sensors;

FIG. **23** is a cross-sectional view illustrating a structure in which electrodes of the touch sensor is further disposed in the display apparatus of FIG. **18**;

FIG. **24** is a perspective view illustrating a display apparatus using a semiconductor light emitting device according to another exemplary embodiment of the present disclosure;

FIG. **25** is a cross-sectional view taken along line C-C of FIG. **16**; and

FIG. **26** is a cross-sectional view illustrating a structure in which electrodes of the touch sensor is disposed on a display unit of the display apparatus of FIG. **24**.

MODE FOR THE INVENTION

Hereinafter, the embodiments disclosed herein will be described in detail with reference to the accompanying drawings, and the same or similar elements are designated with the same numeral references regardless of the numerals in the drawings and their redundant description will be omitted. A suffix "module" or "unit" used for constituent elements disclosed in the following description is merely intended for easy description of the specification, and the suffix itself does not give any special meaning or function. In describing the embodiments disclosed herein, moreover, the detailed description will be omitted when a specific description for publicly known technologies to which the invention pertains is judged to obscure the gist of the present invention. Also, it should be noted that the accompanying drawings are merely illustrated to easily explain the concept of the invention, and therefore, they should not be construed to limit the technological concept disclosed herein by the accompanying drawings.

Furthermore, it will be understood that when an element such as a layer, region or substrate is referred to as being "on" another element, it can be directly on the another element or an intermediate element may also be interposed therebetween.

A display device disclosed herein may include a portable phone, a smart phone, a laptop computer, a digital broadcast terminal, a personal digital assistant (PDA), a portable multimedia player (PMP), a navigation, a slate PC, a tablet PC, an ultrabook, a digital TV, a desktop computer, and the like. However, it would be easily understood by those skilled in the art that a configuration disclosed herein may be applicable to any displayable device even though it is a new product type which will be developed later.

FIG. **1** is a conceptual view illustrating a display device using a semiconductor light emitting device according to an embodiment of the invention.

According to the drawing, information processed in the controller of the display device **100** may be displayed using a flexible display.

The flexible display may include a flexible, bendable, twistable, foldable and rollable display. For example, the flexible display may be a display fabricated on a thin and flexible substrate that can be warped, bent, folded or rolled like a paper sheet while maintaining the display characteristics of a flat display in the related art.

A display area of the flexible display becomes a plane in a configuration that the flexible display is not warped (for example, a configuration having an infinite radius of curvature, hereinafter, referred to as a "first configuration"). The display area thereof becomes a curved surface in a configuration that the flexible display is warped by an external force in the first configuration (for example, a configuration having a finite radius of curvature, hereinafter, referred to as a "second configuration"). As illustrated in the drawing, information displayed in the second configuration may be visual information displayed on a curved surface. The visual information may be implemented by individually controlling the light emission of sub-pixels disposed in a matrix form. The sub-pixel denotes a minimum unit for implementing one color.

The sub-pixel of the flexible display may be implemented by a semiconductor light emitting device. According to the embodiment of the invention, a light emitting diode (LED) is illustrated as a type of semiconductor light emitting device. The light emitting diode may be formed with a small size to perform the role of a sub-pixel even in the second configuration through this.

Hereinafter, a flexible display implemented using the light emitting diode will be described in more detail with reference to the accompanying drawings.

FIG. **2** is a partial enlarged view of portion "A" in FIG. **1**, and FIGS. **3**A and **3**B are cross-sectional views taken along lines B-B and C-C in FIG. **2**, FIG. **4** is a conceptual view illustrating a flip-chip type semiconductor light emitting device in FIG. **3**A, and FIGS. **5**A through **5**C are conceptual views illustrating various forms for implementing colors in connection with a flip-chip type semiconductor light emitting device.

According to the drawings in FIGS. **2**, **3**A and **3**B, there is illustrated a display device **100** using a passive matrix (PM) type semiconductor light emitting device as a display device **100** using a semiconductor light emitting device. However, the following illustration may be also applicable to an active matrix (AM) type semiconductor light emitting device.

The display device **100** may include a substrate **110**, a first electrode **120**, a conductive adhesive layer **130**, a second electrode **140**, and a plurality of semiconductor light emitting devices **150**.

The substrate **110** may be a flexible substrate. The substrate **110** may contain glass or polyimide (PI) to implement the flexible display device. In addition, if it is a flexible material, any one such as polyethylene naphthalate (PEN), polyethylene terephthalate (PET) or the like may be used. Furthermore, the substrate **110** may be either one of transparent and non-transparent materials.

The substrate **110** may be a wiring substrate disposed with the first electrode **120**, and thus the first electrode **120** may be placed on the substrate **110**.

According to the drawing, an insulating layer **160** may be disposed on the substrate **110** placed with the first electrode **120**, and an auxiliary electrode **170** may be placed on the insulating layer **160**. In this instance, a configuration in which the insulating layer **160** is deposited on the substrate **110** may be single wiring substrate. More specifically, the insulating layer **160** may be incorporated into the substrate **110** with an insulating and flexible material such as polyimide (PI), PET, PEN or the like to form single wiring substrate.

The auxiliary electrode **170** as an electrode for electrically connecting the first electrode **120** to the semiconductor light emitting device **150** is placed on the insulating layer **160**, and disposed to correspond to the location of the first electrode **120**. For example, the auxiliary electrode **170** has a dot shape, and may be electrically connected to the first electrode **120** by means of an electrode hole **171** passing through the insulating layer **160**. The electrode hole **171** may be formed by filling a conductive material in a via hole.

Referring to the drawings, the conductive adhesive layer **130** may be formed on one surface of the insulating layer **160**, but the embodiment of the invention may not be necessarily limited to this. For example, it may be possible to also have a structure in which the conductive adhesive layer **130** is disposed on the substrate **110** with no insulating layer **160**. The conductive adhesive layer **130** may perform the role of an insulating layer in the structure in which the conductive adhesive layer **130** is disposed on the substrate **110**.

The conductive adhesive layer **130** may be a layer having adhesiveness and conductivity, and to this end, a conductive material and an adhesive material may be mixed on the conductive adhesive layer **130**. Furthermore, the conductive adhesive layer **130** may have flexibility, thereby allowing a flexible function in the display device.

For such an example, the conductive adhesive layer **130** may be an anisotropic conductive film (ACF), an anisotropic conductive paste, a solution containing conductive particles, and the like. The conductive adhesive layer **130** may allow electrical interconnection in the z-direction passing through the thickness thereof, but may be configured as a layer having electrical insulation in the horizontal x-y direction thereof. Accordingly, the conductive adhesive layer **130** may be referred to as a z-axis conductive layer (however, hereinafter referred to as a "conductive adhesive layer").

The anisotropic conductive film is a film with a form in which an anisotropic conductive medium is mixed with an insulating base member, and thus when heat and pressure are applied thereto, only a specific portion thereof may have conductivity by means of the anisotropic conductive medium. Hereinafter, heat and pressure are applied to the anisotropic conductive film, but other methods may be also available for the anisotropic conductive film to partially have conductivity. The methods may include applying only either one of heat and pressure thereto, UV curing, and the like.

Furthermore, the anisotropic conductive medium may be conductive balls or particles. According to the drawing, in the present embodiment, the anisotropic conductive film is a film with a form in which an anisotropic conductive medium is mixed with an insulating base member, and thus when heat and pressure are applied thereto, only a specific portion thereof may have conductivity by means of the conductive balls. The anisotropic conductive film may be in a state in which a core with a conductive material contains a plurality of particles coated by an insulating layer with a polymer material, and in this instance, it may have conductivity by means of the core while breaking an insulating layer on a portion to which heat and pressure are applied. Here, a core may be transformed to implement a layer having both surfaces to which objects contact in the thickness direction of the film.

For a more specific example, heat and pressure are applied to an anisotropic conductive film as a whole, and electrical connection in the z-axis direction is partially formed by a height difference from a mating object adhered by the use of the anisotropic conductive film.

For another example, an anisotropic conductive film may be in a state containing a plurality of particles in which a conductive material is coated on insulating cores. In this instance, a portion to which heat and pressure are applied may be converted (pressed and adhered) to a conductive material to have conductivity in the thickness direction of the film. For still another example, it may be formed to have conductivity in the thickness direction of the film in which a conductive material passes through an insulating base member in the z-direction. In this instance, the conductive material may have a pointed end portion.

According to the drawing, the anisotropic conductive film may be a fixed array anisotropic conductive film (ACF) configured with a form in which conductive balls are inserted into one surface of the insulating base member. More specifically, the insulating base member is formed of an adhesive material, and the conductive balls are intensively disposed at a bottom portion of the insulating base member, and when heat and pressure are applied thereto, the base member is modified along with the conductive balls, thereby having conductivity in the vertical direction thereof.

However, the embodiment of the invention may not be necessarily limited to this, and the anisotropic conductive film may be all allowed to have a form in which conductive balls are randomly mixed with an insulating base member or a form configured with a plurality of layers in which conductive balls are disposed at any one layer (double-ACF), and the like.

The anisotropic conductive paste as a form coupled to a paste and conductive balls may be a paste in which conductive balls are mixed with an insulating and adhesive base material. Furthermore, a solution containing conductive particles may be a solution in a form containing conductive particles or nano particles.

Referring to the drawing again, the second electrode **140** is located at the insulating layer **160** to be separated from the auxiliary electrode **170**. In other words, the conductive adhesive layer **130** is disposed on the insulating layer **160** located with the auxiliary electrode **170** and second electrode **140**.

When the conductive adhesive layer **130** is formed in a state that the auxiliary electrode **170** and second electrode **140** are located, and then the semiconductor light emitting device **150** is connected thereto in a flip chip form with the application of heat and pressure, the semiconductor light emitting device **150** is electrically connected to the first electrode **120** and second electrode **140**.

Referring to FIG. **4**, the semiconductor light emitting device may be a flip chip type semiconductor light emitting device.

For example, the semiconductor light emitting device may include a p-type electrode **156**, a p-type semiconductor layer **155** formed with the p-type electrode **156**, an active layer **154** formed on the p-type semiconductor layer **155**, an n-type semiconductor layer **153** formed on the active layer **154**, and an n-type electrode **152** disposed to be separated from the p-type electrode **156** in the horizontal direction on the n-type semiconductor layer **153**. In this instance, the p-type electrode **156** may be electrically connected to a welding portion by the conductive adhesive layer **130**, and the n-type electrode **152** may be electrically connected to the second electrode **140**.

Referring to FIGS. **2**, **3**A and **3**B again, the auxiliary electrode **170** may be formed in an elongated manner in one direction to be electrically connected to a plurality of semiconductor light emitting devices **150**. For example, the left and right p-type electrodes of the semiconductor light emitting devices around the auxiliary electrode may be electrically connected to one auxiliary electrode.

More specifically, the semiconductor light emitting device **150** is pressed into the conductive adhesive layer **130**, and through this, only a portion between the p-type electrode **156** and auxiliary electrode **170** of the semiconductor light emitting device **150** and a portion between the n-type electrode **152** and second electrode **140** of the semiconductor light emitting device **150** have conductivity, and the remaining portion does not have conductivity since there is no push-down of the semiconductor light emitting device.

Furthermore, a plurality of semiconductor light emitting devices **150** constitute a light-emitting array, and a phosphor layer **180** is formed on the light-emitting array.

The light emitting device may include a plurality of semiconductor light emitting devices with different self luminance values. Each of the semiconductor light emitting devices **150** constitutes a sub-pixel, and is electrically connected to the first electrode **120**. For example, there may exist a plurality of first electrodes **120**, and the semiconductor light emitting devices are arranged in several rows, for instance, and each row of the semiconductor light emitting devices may be electrically connected to any one of the plurality of first electrodes.

Furthermore, the semiconductor light emitting devices may be connected in a flip chip form, and thus semiconductor light emitting devices are grown on a transparent dielectric substrate. Furthermore, the semiconductor light emitting devices may be nitride semiconductor light emitting devices, for instance. The semiconductor light emitting device **150** has an excellent luminance characteristic, and thus it may be possible to configure individual sub-pixels even with a small size thereof.

According to the drawing, a partition wall **190** may be formed between the semiconductor light emitting devices **150**. In this instance, the partition wall **190** may perform the role of dividing individual sub-pixels from one another, and be formed as an integral body with the conductive adhesive layer **130**. For example, a base member of the anisotropic conductive film may form the partition wall when the semiconductor light emitting device **150** is inserted into the anisotropic conductive film.

Furthermore, when the base member of the anisotropic conductive film is black, the partition wall **190** may have reflective characteristics while at the same time increasing contrast with no additional black insulator.

For another example, a reflective partition wall may be separately provided with the partition wall **190**. In this instance, the partition wall **190** may include a black or white insulator according to the purpose of the display device. It may have an effect of enhancing reflectivity when the partition wall of the while insulator is used, and increase contrast while at the same time having reflective characteristics.

The phosphor layer **180** may be located at an outer surface of the semiconductor light emitting device **150**. For example, the semiconductor light emitting device **150** is a blue semiconductor light emitting device that emits blue (B) light, and the phosphor layer **180** performs the role of converting the blue (B) light into the color of a sub-pixel. The phosphor layer **180** may be a red phosphor layer **181** or green phosphor layer **182** constituting individual pixels.

In other words, a red phosphor **181** capable of converting blue light into red (R) light may be deposited on the blue semiconductor light emitting device **151** at a location implementing a red sub-pixel, and a green phosphor **182** capable of converting blue light into green (G) light may be deposited on the blue semiconductor light emitting device **151** at a location implementing a green sub-pixel. Furthermore, only the blue semiconductor light emitting device **151** may be solely used at a location implementing a blue sub-pixel. In this instance, the red (R), green (G) and blue (B) sub-pixels may implement one pixel. More specifically, one color phosphor may be deposited along each line of the first electrode **120**. Accordingly, one line on the first electrode **120** may be an electrode controlling one color. In other words, red (R), green (B) and blue (B) may be sequentially disposed, thereby implementing sub-pixels.

However, the embodiment of the invention may not be necessarily limited to this, and the semiconductor light emitting device **150** may be combined with a quantum dot (QD) instead of a phosphor to implement sub-pixels such as red (R), green (G) and blue (B).

Furthermore, a black matrix **191** may be disposed between each phosphor layer to enhance contrast. In other words, the black matrix **191** can enhance the contrast of luminance.

However, the embodiment of the invention may not be necessarily limited to this, and another structure for implementing blue, red and green may be also applicable thereto.

Referring to FIG. **5**A, each of the semiconductor light emitting devices **150** may be implemented with a high-power light emitting device that emits various lights including blue in which gallium nitride (GaN) is mostly used, and indium (In) and or aluminum (Al) are added thereto.

In this instance, the semiconductor light emitting device **150** may be red, green and blue semiconductor light emitting devices, respectively, to implement each sub-pixel. For instance, red, green and blue semiconductor light emitting devices (R, G, B) are alternately disposed, and red, green and blue sub-pixels implement one pixel by means of the red, green and blue semiconductor light emitting devices, thereby implementing a full color display.

Referring to FIG. **5**B, the semiconductor light emitting device may have a white light emitting device (W) provided with a yellow phosphor layer for each element. In this instance, a red phosphor layer **181**, a green phosphor layer **182** and blue phosphor layer **183** may be provided on the white light emitting device (W) to implement a sub-pixel. Furthermore, a color filter repeated with red, green and blue on the white light emitting device (W) may be used to implement a sub-pixel.

Referring to FIG. **5**C, it may be possible to also have a structure in which a red phosphor layer **181**, a green phosphor layer **182** and blue phosphor layer **183** may be provided on a ultra violet light emitting device (UV). In this manner, the semiconductor light emitting device can be used over the entire region up to ultra violet (UV) as well as visible light, and may be extended to a form of semiconductor light emitting device in which ultra violet (UV) can be used as an excitation source.

Taking the present example into consideration again, the semiconductor light emitting device **150** is placed on the conductive adhesive layer **130** to configure a sub-pixel in the display device. The semiconductor light emitting device **150** may have excellent luminance characteristics, and thus it may be possible to configure individual sub-pixels even with a small size thereof. The size of the individual semiconductor light emitting device **150** may be less than 80 μm in the length of one side thereof, and formed with a rectangular or square shaped element. In case of a rectangular shaped element, the size thereof may be less than 20×80 μm.

Furthermore, even when a square shaped semiconductor light emitting device **150** with a length of side of 10 μm is used for a sub-pixel, it will exhibit a sufficient brightness for implementing a display device. Accordingly, for example, in case of a rectangular pixel in which one side of a sub-pixel is 600 μm in size, and the remaining one side thereof is 300 μm, a relative distance between the semiconductor light emitting devices becomes sufficiently large. Accordingly, in this instance, it may be possible to implement a flexible display device having a HD image quality.

A display device using the foregoing semiconductor light emitting device will be fabricated by a new type of fabrication method. Hereinafter, the fabrication method will be described with reference to FIG. **6**.

FIG. **6** is cross-sectional views illustrating a method of fabricating a display device using a semiconductor light emitting device according to the embodiment of the invention.

Referring to the drawing, first, the conductive adhesive layer **130** is formed on the insulating layer **160** located with the auxiliary electrode **170** and second electrode **140**. The insulating layer **160** is deposited on the first substrate **110** to form one substrate (or wiring substrate), and the first electrode **120**, auxiliary electrode **170** and second electrode **140** are disposed at the wiring substrate. In this instance, the first electrode **120** and second electrode **140** may be disposed in a perpendicular direction to each other. Furthermore, the first substrate **110** and insulating layer **160** may contain glass or polyimide (PI), respectively, to implement a flexible display device.

The conductive adhesive layer **130** may be implemented by an anisotropic conductive film, for example, and to this end, an anisotropic conductive film may be coated on a substrate located with the insulating layer **160**.

Next, a second substrate **112** located with a plurality of semiconductor light emitting devices **150** corresponding to the location of the auxiliary electrodes **170** and second electrodes **140** and constituting individual pixels is disposed such that the semiconductor light emitting device **150** faces the auxiliary electrode **170** and second electrode **140**.

In this instance, the second substrate **112** as a growth substrate for growing the semiconductor light emitting device **150** may be a sapphire substrate or silicon substrate.

The semiconductor light emitting device may have a gap and size capable of implementing a display device when formed in the unit of wafer, and thus effectively used for a display device.

Next, the wiring substrate is thermally compressed to the second substrate **112**. For example, the wiring substrate and second substrate **112** may be thermally compressed to each other by applying an ACF press head. The wiring substrate and second substrate **112** are bonded to each other using the thermal compression. Only a portion between the semiconductor light emitting device **150** and the auxiliary electrode **170** and second electrode **140** may have conductivity due to the characteristics of an anisotropic conductive film having conductivity by thermal compression, thereby allowing the electrodes and semiconductor light emitting device **150** to be electrically connected to each other. At this time, the semiconductor light emitting device **150** may be inserted into the anisotropic conductive film, thereby forming a partition wall between the semiconductor light emitting devices **150**.

Next, the second substrate **112** is removed. For example, the second substrate **112** may be removed using a laser lift-off (LLO) or chemical lift-off (CLO) method.

Finally, the second substrate **112** is removed to expose the semiconductor light emitting devices **150** to the outside. Silicon oxide (SiOx) or the like may be coated on the wiring substrate coupled to the semiconductor light emitting device **150** to form a transparent insulating layer.

Furthermore, it may further include the process of forming a phosphor layer on one surface of the semiconductor light emitting device **150**. For example, the semiconductor light emitting device **150** may be a blue semiconductor light emitting device for emitting blue (B) light, and red or green phosphor for converting the blue (B) light into the color of the sub-pixel may form a layer on one surface of the blue semiconductor light emitting device.

The fabrication method or structure of a display device using the foregoing semiconductor light emitting device may be modified in various forms. For such an example, the foregoing display device may be applicable to a vertical semiconductor light emitting device. Hereinafter, the vertical structure will be described with reference to FIGS. **5** and **6**.

Furthermore, according to the following modified example or embodiment, the same or similar reference numerals are designated to the same or similar configurations to the foregoing example, and the description thereof will be substituted by the earlier description.

FIG. **7** is a perspective view illustrating a display device using a semiconductor light emitting device according to another embodiment of the invention. FIG. **8** is a cross-sectional view taken along line C-C in FIG. **7**, and FIG. **9** is a conceptual view illustrating a vertical type semiconductor light emitting device in FIG. **8**.

According to the drawings, the display device may be display device using a passive matrix (PM) type of vertical semiconductor light emitting device.

The display device may include a substrate **210**, a first electrode **220**, a conductive adhesive layer **230**, a second electrode **240** and a plurality of semiconductor light emitting devices **250**.

The substrate **210** as a wiring substrate disposed with the first electrode **220** may include polyimide (PI) to implement a flexible display device. In addition, any one may be used if it is an insulating and flexible material.

The first electrode **220** may be located on the substrate **210**, and formed with an electrode having a bar elongated in one direction. The first electrode **220** may be formed to perform the role of a data electrode.

The conductive adhesive layer **230** is formed on the substrate **210** located with the first electrode **220**. Similarly to a display device to which a flip chip type light emitting device is applied, the conductive adhesive layer **230** may be an anisotropic conductive film (ACF), an anisotropic conductive paste, a solution containing conductive particles, and the like. However, the present embodiment illustrates a case where the conductive adhesive layer **230** is implemented by an anisotropic conductive film.

When an anisotropic conductive film is located in a state that the first electrode **220** is located on the substrate **210**, and then heat and pressure are applied to connect the semiconductor light emitting device **250** thereto, the semiconductor light emitting device **250** is electrically connected to the first electrode **220**. At this time, the semiconductor light emitting device **250** may be preferably disposed on the first electrode **220**.

The electrical connection is generated because an anisotropic conductive film partially has conductivity in the thickness direction when heat and pressure are applied as described above. Accordingly, the anisotropic conductive film is partitioned into a portion **231** having conductivity and a portion **232** having no conductivity in the thickness direction thereof.

Furthermore, the anisotropic conductive film contains an adhesive component, and thus the conductive adhesive layer **230** implements a mechanical coupling as well as an electrical coupling between the semiconductor light emitting device **250** and the first electrode **220**.

In this manner, the semiconductor light emitting device **250** is placed on the conductive adhesive layer **230**, thereby configuring a separate sub-pixel in the display device. The semiconductor light emitting device **250** may have excellent luminance characteristics, and thus it may be possible to configure individual sub-pixels even with a small size thereof. The size of the individual semiconductor light emitting device **250** may be less than 80 μm in the length of one side thereof, and formed with a rectangular or square shaped element. In case of a rectangular shaped element, the size thereof may be less than 20×80 μm.

The semiconductor light emitting device **250** may be a vertical structure.

A plurality of second electrodes **240** disposed in a direction crossed with the length direction of the first electrode **220**, and electrically connected to the vertical semiconductor light emitting device **250** may be located between vertical semiconductor light emitting devices.

Referring to FIG. **9**, the vertical semiconductor light emitting device may include a p-type electrode **256**, a p-type semiconductor layer **255** formed with the p-type electrode **256**, an active layer **254** formed on the p-type semiconductor layer **255**, an n-type semiconductor layer **253** formed on the active layer **254**, and an n-type electrode **252** formed on the n-type semiconductor layer **253**. In this instance, the p-type electrode **256** located at the bottom thereof may be electrically connected to the first electrode **220** by the conductive adhesive layer **230**, and the n-type electrode **252** located at the top thereof may be electrically connected to the second electrode **240** which will be described later. The electrodes may be disposed in the upward/downward direction in the vertical semiconductor light emitting device **250**, thereby providing a great advantage capable of reducing the chip size.

Referring to FIG. **8** again, a phosphor layer **280** may be formed on one surface of the semiconductor light emitting device **250**. For example, the semiconductor light emitting device **250** is a blue semiconductor light emitting device **251** that emits blue (B) light, and the phosphor layer **280** for converting the blue (B) light into the color of the sub-pixel may be provided thereon. In this instance, the phosphor layer **280** may be a red phosphor **281** and a green phosphor **282** constituting individual pixels.

In other words, a red phosphor **281** capable of converting blue light into red (R) light may be deposited on the blue semiconductor light emitting device **251** at a location implementing a red sub-pixel, and a green phosphor **282** capable of converting blue light into green (G) light may be deposited on the blue semiconductor light emitting device **251** at a location implementing a green sub-pixel. Furthermore, only the blue semiconductor light emitting device **251** may be solely used at a location implementing a blue sub-pixel. In this instance, the red (R), green (G) and blue (B) sub-pixels may implement one pixel.

However, the embodiment of the invention may not be necessarily limited to this, and another structure for implementing blue, red and green may be also applicable thereto as described above in a display device to which a flip chip type light emitting device is applied.

Taking the present embodiment into consideration again, the second electrode **240** is located between the semiconductor light emitting devices **250**, and electrically connected to the semiconductor light emitting devices **250**. For example, the semiconductor light emitting devices **250** may be disposed in a plurality of rows, and the second electrode **240** may be located between the rows of the semiconductor light emitting devices **250**.

Since a distance between the semiconductor light emitting devices **250** constituting individual pixels is sufficiently large, the second electrode **240** may be located between the semiconductor light emitting devices **250**.

The second electrode **240** may be formed with an electrode having a bar elongated in one direction, and disposed in a perpendicular direction to the first electrode.

Furthermore, the second electrode **240** may be electrically connected to the semiconductor light emitting device **250** by a connecting electrode protruded from the second electrode **240**. More specifically, the connecting electrode may be an n-type electrode of the semiconductor light emitting device **250**. For example, the n-type electrode is formed with an ohmic electrode for ohmic contact, and the second electrode covers at least part of the ohmic electrode by printing or deposition. Through this, the second electrode **240** may be electrically connected to the n-type electrode of the semiconductor light emitting device **250**.

According to the drawing, the second electrode **240** may be located on the conductive adhesive layer **230**. According to circumstances, a transparent insulating layer containing silicon oxide (SiOx) may be formed on the substrate **210** formed with the semiconductor light emitting device **250**. When the transparent insulating layer is formed and then the second electrode **240** is placed thereon, the second electrode **240** may be located on the transparent insulating layer. Furthermore, the second electrode **240** may be formed to be separated from the conductive adhesive layer **230** or transparent insulating layer.

If a transparent electrode such as indium tin oxide (ITO) is used to locate the second electrode **240** on the semiconductor light emitting device **250**, the ITO material has a problem of bad adhesiveness with an n-type semiconductor. Accordingly, the second electrode **240** may be placed between the semiconductor light emitting devices **250**, thereby obtaining an advantage in which the transparent electrode is not required. Accordingly, an n-type semiconductor layer and a conductive material having a good adhesiveness may be used as a horizontal electrode without being restricted by the selection of a transparent material, thereby enhancing the light extraction efficiency.

According to the drawing, a partition wall **290** may be formed between the semiconductor light emitting devices **250**. In other words, the partition wall **290** may be disposed between the vertical semiconductor light emitting devices **250** to isolate the semiconductor light emitting device **250** constituting individual pixels. In this instance, the partition wall **290** may perform the role of dividing individual sub-pixels from one another, and be formed as an integral body with the conductive adhesive layer **230**. For example, a base member of the anisotropic conductive film may form the partition wall when the semiconductor light emitting device **250** is inserted into the anisotropic conductive film.

Furthermore, when the base member of the anisotropic conductive film is black, the partition wall **290** may have reflective characteristics while at the same time increasing contrast with no additional black insulator.

For another example, a reflective partition wall may be separately provided with the partition wall **290**. In this instance, the partition wall **290** may include a black or white insulator according to the purpose of the display device.

If the second electrode **240** is precisely located on the conductive adhesive layer **230** between the semiconductor light emitting devices **250**, the partition wall **290** may be located between the semiconductor light emitting device **250** and second electrode **240**. Accordingly, individual sub-pixels may be configured even with a small size using the semiconductor light emitting device **250**, and a distance between the semiconductor light emitting devices **250** may be relatively sufficiently large to place the second electrode **240** between the semiconductor light emitting devices **250**, thereby having the effect of implementing a flexible display device having a HD image quality.

Furthermore, according to the drawing, a black matrix **291** may be disposed between each phosphor layer to enhance contrast. In other words, the black matrix **191** can enhance the contrast of luminance.

As described above, the semiconductor light emitting device **250** is located on the conductive adhesive layer **230**, thereby constituting individual pixels on the display device. Since the semiconductor light emitting device **250** has excellent luminance characteristics, thereby configuring individual sub-pixels even with a small size thereof. As a result, it may be possible to implement a full color display in which the sub-pixels of red (R), green (G) and blue (B) implement one pixel by means of the semiconductor light emitting device.

The display apparatus described above may further include a touch sensor for sensing a touch operation applied to the display apparatus.

The display apparatus having the touch sensor may include a display unit (or a display module) and the touch sensor and may be used as an input device as well as an output device.

The touch sensor can sense a touch applied to the display apparatus using any of a variety of touch methods. Examples of such touch methods include a resistive type, a capacitive type, an infrared type, a ultrasonic type, and a magnetic field type, among others. Hereinafter, a structure of the display apparatus having a touch sensor that senses a touch in a capacitive manner will be described in detail. However, the structure of the touch sensor according to an exemplary embodiment of the present invention is not limited only to the capacitive scheme. For example, a magnetic field type including a magnetic field coil may be applied to the touch sensor. In this case, any one of an X electrode and a Y electrode based on a capacitive scheme may be a magnetic coil and the other may be omitted.

The touch sensor that senses a touch in the capacitive manner may be configured to convert a pressure applied to a particular portion of a display module or a change in capacitance generated in a particular portion of the display module, into an electrical input signal. When a touch input is applied to the touch sensor, corresponding signal(S) may be processed by a controller of the display apparatus, and the processed signal may be converted into corresponding data. Hereinafter, a display apparatus based on a capacitive scheme will be described in detail with reference to the accompanying drawings. FIG. **10** is a conceptual view illustrating an example of a display apparatus including a touch sensor.

As illustrated in FIG. **10**, information processed by a controller of a display apparatus **1000** may be displayed using a flexible display. Descriptions of FIG. **1** will be used as descriptions of the flexible display.

As illustrated, the display apparatus **1000** configured as a flexible display may have a touch sensor. For example, as illustrated in (a) of FIG. **10**, when a touch input is applied to the display apparatus **1000**, the controller (not shown) may process the touch input and perform controlling corresponding to the processed touch input. For example, when a touch input is applied to a certain icon **1001** in (a) of FIG. **10**, corresponding screen information may be output to the display apparatus **1000**. In this case, the touch input may be applied to the flexible display in a bent state, and the touch sensor is configured to sense the touch input applied in the state.

In the display apparatus **1000** configured as a flexible display, a unit pixel may be formed by a semiconductor light emitting device. In an exemplary embodiment of the present disclosure, a light emitting diode (LED) is illustrated as a type of a semiconductor light emitting device that converts a current into light. The LED has a small size, and thus, the LED may serve as a unit pixel even in the second state.

Hereinafter, a flexible display implemented using an LED and having a touch sensor will be described in detail with reference to the accompanying drawings. FIG. **11** is an enlarged view of portion 'A' of FIG. **10**, and FIGS. **12**A and **12**B are cross-sectional views taken along lines B-B and C-C of FIG. **11**.

As illustrated in FIGS. **11**, **12**A, and **12**B, the display apparatus **1000** using a passive matrix (PM) type semiconductor light emitting device is illustrated as a display apparatus **1000** using a semiconductor light emitting device. However, the present disclosure described hereinafter may also be applied to an active matrix (AM) type semiconductor light emitting device.

The display apparatus **1000** may include a display unit **1000*a*** forming screen information by emitting R, G, and B light and a touch sensor **1100** sensing a touch input applied to the display apparatus **1000**. Hereinafter, in the exemplary embodiment or the modified example described hereinafter, the like or similar reference numerals are given to components identical or similar to those of the former example, and redundant description thereof will be omitted.

The display unit **1000*a*** includes a board **1010**, a first electrode **1020**, a conductive bonding layer **1030**, a second electrode **1040**, and a plurality of semiconductor light emitting devices **1050**. Here, the first electrode **1020** and the second electrode **1040** may include a plurality of electrode lines, respectively.

The board **1010** may be a wiring board on which a plurality electrode lines included in the first electrode **1020** are disposed, and thus, the first electrode **1020** may be positioned on the board **1010**. Also, the second electrode **1040** is disposed on the board **1010**. For example, the board **1010** may be a wiring board including a plurality of layers, and the first electrode **1020** and the second electrode **1040** may be formed on each of the plurality of layers. In this case, the wiring board may be a board in which the board **110** and the insulating layer **160** of the display apparatus described above with reference to FIGS. **3**A and **3**B are integrally formed of a material having insulating properties and flexibility such as polyimide (PI), PET, PEN, or the like.

As illustrated, the first electrode **1020** and the second electrode **1030** are electrically connected to a plurality of semiconductor light emitting devices **1050**. In this case, the first electrode **1020** may be connected to the plurality of semiconductor light emitting devices **1050** by the medium of an auxiliary electrode **1070** disposed to be coplanar with the second electrode **1030**. The first electrode **1020** and the second electrode **1040** may be electrically connected to the plurality of semiconductor light emitting devices **1050** by a conductive bonding layer **1030** disposed on one surface of the board **1010**.

The conductive bonding layer **1030** may be a layer having adhesion and conductivity, and to this end, the conductive bonding layer **1030** may be formed of a mixture of a material having conductivity and a material having adhesion. Also, the conductive bonding layer **1030** may have ductility to enable the display apparatus to have a flexible function.

For example, the conductive bonding layer **1030** may be an anisotropy conductive film (ACF), anisotropy conductive paste, or a solution containing conductive particles, for example. In a state in which the auxiliary electrode **1070** and the second electrode **1040** are positioned, the conductive bonding layer **1030** is formed, and thereafter, when the semiconductor light emitting devices **1050** are connected in a flipchip manner by applying heat and pressure thereto, the semiconductor light emitting devices **1050** are electrically connected to the first electrode **1020** and the second electrode **1040**.

In this manner, the plurality of semiconductor light emitting devices **1050** are coupled to the conductive bonding layer **1030**, forming a plurality of rows along at least one of the plurality of electrode lines.

As illustrated, the plurality of semiconductor light emitting devices **1050** may form a plurality of rows in a direction parallel to the plurality of electrode lines provided in the first electrode **1020**. However, the present disclosure is not limited thereto, and for example, the plurality of semiconductor light emitting devices **1050** may form a plurality of rows along the second electrode **1040**.

In addition, the display unit **1000***a* may further include a phosphor layer **1080** formed on one surface of the plurality of semiconductor light emitting devices **1050**. For example, the semiconductor light emitting device **1050** may be a blue semiconductor light emitting device emitting blue (B) light, and the phosphor layer **1080** serves to convert the blue (B) light into a color of a unit pixel. The phosphor layer **1080** may be a red phosphor **1081** or a green phosphor **1082** constituting an individual pixel. Namely, in a position forming a red unit pixel, the red phosphor **1081** capable of converting blue light into red (R) light may be stacked on the blue semiconductor light emitting device **1050**, and in a position forming a green unit pixel, the green phosphor **1082** capable of converting blue light into green (G) light may be stacked on the blue semiconductor light emitting device **1050**. Also, in a portion forming a blue unit pixel, only the blue semiconductor light emitting device **1050** may be used alone. In this case, the red (R), green (G), and blue (B) unit pixels may constitute a single pixel, respectively. In detail, a phosphor of one color may be stacked along each line of the first electrode **1020**. Thus, one line of the first electrode **1020** may be an electrode controlling one color. Namely, the red (R), green (G), and blue (B) phosphors may be disposed in sequence along the second electrode **1040**, thus forming unit pixels. However, the present disclosure is not limited thereto and the semiconductor light emitting devices **1050** and quantum dots (QD), instead of phosphors, may be combined with form unit pixels emitting red (R), green (G), and blue (B).

Meanwhile, in order to increase contrast of the phosphor layer **1080**, the display unit **1000***a* may further include a black matrix **1091** disposed between phosphors. The black matrix **1091** may be formed by forming a gap between phosphor dots and filling the gap with a black material. Accordingly, the black matrix **1901** may absorb reflection of external light and increase the contrast. The black matrix **1091** is positioned between the phosphor layers **1080** along the first electrode **1020** in a direction in which the phosphor layers **1080** are stacked. In this case, a phosphor layer is not formed in a position corresponding to the blue semiconductor light emitting device **1051**, but the black matrix **1091** may be formed on both sides of the space without the phosphor layer (on both sides of the blue semiconductor light emitting device **1050**).

The touch sensor **1100** operating cooperatively with the display unit **1000***a* including the configuration as described above includes an X electrode **1110**, a Y electrode **1130** stacked on the display unit, and a spacer **1120** separating the X and Y electrodes **1110** and **1130**. The X and Y electrodes **1110** and **1130** are arranged in directions in which they cross each other, and receive electric charges from a power supply unit (not shown). Thus, in a state in which a potential difference is formed between the X and Y electrodes **1110** and **1130**, when the display apparatus **1000** is touched with a conductor, for example, a user's finger, or the like, quantities of electric charge charged in the X and Y electrodes **1110** and **1130** are changed, respectively. Based on the change in the quantities of electric charges, the controller (not shown) may calculate positions of an X axis and a Y axis, and a touched input point may be specified by the calculation value. Meanwhile, in the present disclosure, the X electrode and the Y electrode are relative concepts, rather than having a general meaning of the terms. Thus, the X electrode is not necessarily identical to an X-axis direction and the Y electrode is not necessarily identical to an Y-axis direction. Namely, When any one of the X electrode and the Y electrode is in the X-axis direction, the other may be in the Y-axis direction.

Positions of the X electrode **1110** and the Y electrode **1130** of the touch sensor **1100** in the display apparatus **1000** will be described in detail. As illustrated, the X electrode **1110** of the touch sensor **1100** is disposed between the semiconductor light emitting devices **1050** forming a plurality of rows in the display unit **1100***a*. In detail, as illustrated in FIG. **12**B, the X electrode **1110** may be disposed between the plurality of rows on the conductive bonding layer **1030**. Since spaces between the plurality of rows form a plurality of parallel lines, the X electrode **1110** may be inserted into the stacked structure of the display unit **1110***a*, and thus, a touch screen having a good touch sense and having a reduced thickness may be formed.

In a specific example, the X electrode **1110** includes a plurality of electrode lines, and the plurality of electrode lines of the X electrode **1110** are disposed to be separated in a horizontal direction between the semiconductor light emitting devices **1050** forming the plurality of rows. Thus, the X electrode **1110** may be positioned in the position of the black matrix **1091** (between the phosphor layers or between the semiconductor light emitting devices). In a case in which the X electrode **1110** is disposed in the position of the black matrix **1091**, the X electrode **1110** may be formed to be covered by the black matrix **1091** or may cover the black matrix **1091**.

In this manner, since the electrodes **1110** and the black matrix **1091** overlap, the black matrix **1091** and the X electrode **1110** may be positioned together between the phosphor layers.

In addition, the X electrode **1110** of the touch sensor **1100** may be positioned inside the display unit **1000***a*, while the Y electrode **1130** of the touch sensor **1100** may be positioned outside the display unit **1000***a*. As illustrated, the Y electrode **1130** is disposed to overlap the plurality of semiconductor light emitting devices **1050** outside the display unit **1000***a*, and combined with the X electrode **1110** to sense a touch input. The Y electrode **1130** may be formed on an electrode film **1140** formed of a light-transmissive material allowing light emitted from the plurality of semiconductor light emitting devices **1050** to be transmitted therethrough. As illustrated, the Y electrode **1130** may protrude from one surface of the electrode film **1140** and may be formed inside the electrode film **1140**. In a case in which the Y electrode

1130 is formed inside the electrode film **1140**, the electrode film **1140** may be formed as a plurality of layers.

The spacer **1120** of the touch sensor **1100** serves to separate the X electrode **1110** and the Y electrode **1130** in a thickness direction of the display apparatus. However, the function of the spacer **1120** is not limited thereto. For example, the spacer **1120** may be understood to serve to fill a space between the X electrode **1110** and the Y electrode **1130**.

The spacer **1120** may be formed as a light-transmissive member to allow light emitted from the plurality of semiconductor light emitting devices **1050** to be transmitted therethrough. The spacer **1120** is disposed between the electrode film **1140** and the plurality of semiconductor light emitting devices **1050**. The spacer **1120** may be, for example, an optically clear adhesive (OCA) (or an optically clear adhesive film), a non-reflection film (or a low reflection film), or the like.

In a case in which the spacer **1120** is an optically clear adhesive, the electrode film **1140** and the black matrix may be coupled by the spacer **1120**.

In another example, in a case in which the spacer **1120** is a non-reflection film, light is not reflected in the display apparatus, preventing a degradation of optical performance of the plurality of semiconductor light emitting devices **1050**. In this case, the spacer **1120** may be a component of the display unit.

In another example, the spacer **1120** may include a plurality of layers formed by stacking optical clear adhesive and non-reflection films. In this case, the non-reflective films may be bonded by the optically clear adhesive. To sum up, the spacer **1120** may be defined as a member disposed in the spaces of the X electrode **1110** and the Y electrode **1130** to become a component of the touch sensor or a component of the display unit.

As described above, in the display apparatus **1000** according to an exemplary embodiment of the present disclosure, by positioning any one of the X electrode **1110** and the Y electrode **1120** forming the touch sensor **1100** in the display unit **1000***a*, a thickness of the touch sensor **1100** in a Z-axis direction can be reduced.

Meanwhile, the black matrix **1091** as described above may be formed of a material having a resistance value different from that of the X electrode **1110** and including a black material. Also, the black material **1091** may be formed of a material having conductivity. Thus, as illustrated in FIGS. **13**A and **13**B, the X electrode **1110** and the black matrix **1091** described above with reference to FIGS. **11**, **12**A and **12**B may have a structure different from the structure in which they are stacked at corresponding positions.

For example, when the black matrix **1091** is formed of a material including a black material and having a resistance value appropriate for the X electrode **1110** of the touch sensor **1100** to be formed, the X electrode **1110** of the touch sensor **1100** and the black matrix **1091** may be formed as a single layer. In this case, the X electrode may be formed of a black material to alleviate reflection between the phosphors **1080** provided in the display unit **1000***a*. Namely, the X electrode **1110** may be formed as a single layer between the phosphor layers **1080**.

In this manner, the X electrode **1110** of the touch sensor **1100** may serve as both an electrode and a black matrix **1091**. Thus, in this case, the black matrix **1091** may be both a component of the display unit **1000***a* and a component of the touch sensor **1100**.

So far, the case in which the display unit **1000***a* includes the blue semiconductor light emitting device that emits blue (B) light has been described, but the present disclosure is not limited thereto and any other structure for implementing blue, red, and green colors may be applied. FIGS. **14**A, **14**B, and **14**C are conceptual views illustrating various configurations implementing color in relation to a flipchip type semiconductor light emitting device to which the present invention is applied and various types of stacked structures for implementing touch sensors.

Referring to FIG. **14**A, each semiconductor light emitting device **1050** may be formed as a high output light emitting device, which formed of gallium nitride (GaN) as a main ingredient with indium (In) and/or aluminum (Al) added thereto, emitting light of various colors including blue light.

In this case, the semiconductor light emitting devices **150** may be red, green, and blue semiconductor light emitting devices forming unit pixels, respectively. For example, the red, green, and blue semiconductor light emitting devices R, G, and B may be alternately disposed, and red, green, and blue unit pixels constitute a single pixel by the red, green, and blue semiconductor light emitting devices, whereby a full color display may be implemented. The semiconductor light emitting devices may have an array structure forming a plurality of rows. In this case, the semiconductor light emitting devices that emit the same color may be disposed to correspond to the same row. For example, the semiconductor light emitting devices may be disposed in a plurality of rows along the plurality of first electrode lines **1020**, and each of the lows may include semiconductor light emitting devices that emit light of the same color.

In the case in which the semiconductor light emitting devices implements R, G, and B, independently, a phosphor may not be provided. Meanwhile, even in this case, in order to enhance contrast and reflect external light, the display unit **1000***a* may further include the black matrix **1091** disposed between the plurality of rows of the semiconductor light emitting devices. As illustrated, the black matrix **1091** may be disposed to be spaced apart from each other in a horizontal direction. In addition, even in the structure, similar to the structure as described above, the X electrode **1110** of the touch sensor **1100** may be disposed in a position in which the black matrix **1091** is disposed. Namely, as illustrated, the X electrode **1110** of the touch sensor **1100** may be disposed between the semiconductor light emitting devices forming a plurality of rows, in particular, in a position corresponding to where the black matrix **1091** is disposed, in the display unit **1000***a*. The structure in which the X electrode is disposed in the position of the black matrix **1091** may employ the structure illustrated in FIGS. **12**A and **12**B, and a detailed description thereof will be replaced with the description of FIGS. **12**A and **12**B.

Meanwhile, although not shown, when the black matrix **1091** is formed of a material including a black material having conductivity and having a resistance value appropriate for the X electrode **11100** of the touch sensor **1100** to be formed, the X electrode **1110** of the touch sensor **1100** and the black matrix **1091** may be formed as a single layer.

The spacer **1120***a* may include a transparent resin to fill a space of the X electrode **1110** and the Y electrode **1130**. For example, the transparent resin may be a PET film. In another example, the spacer **1120***a* may include a plurality of layers in which an optical clear adhesive and a transparent resin are stacked. In this case, the optical clear adhesive is stacked on the black matrix and a PET film may be stacked on the optical clear adhesive. In this manner, the stacked structure of the isolating member **1120***a* may be variously modified.

Thus, in the present example, the spacer **1120***a* may be replaced with the spacer **1120** illustrated in FIGS. **12**A and **12**B. In addition, various modified examples of the spacer described in the present disclosure may be replaced unless impossible.

In another example, referring to FIG. **14**B, the semiconductor light emitting device may include white light emitting devices W in which a yellow phosphor layer is provided in every individual device. In this case, a phosphor layer may be formed on an upper surface of each of the white light emitting devices W. Also, in order to form unit pixels, a red phosphor layer **1081**, a green phosphor layer **1082**, and a blue phosphor layer **1083** may be provided on the white light emitting devices W.

Also, unit pixels may be formed by using repeated red, green, and blue color filters on the white light emitting devices W.

Meanwhile, even in this case, in order to increase contrast and reflect external light, the display unit **1000***a* may further include the black matrix **1091** disposed between a plurality of rows of the semiconductor light emitting devices. The black matrix **1091** may be disposed between the red phosphor layer **1081**, the green phosphor layer **1082**, and the blue phosphor layer **1083**, and even in this structure, like the structure as described above, the X electrode **1110** of the touch sensor **1100** may be disposed in a position where the black matrix **1091** is disposed. Thus, the X electrode **1110** of the touch sensor **1100** may be positioned between the red phosphor layer **1081**, the green phosphor layer **1082**, and the blue phosphor layer **1083**. Meanwhile, although not shown, when the black matrix **1091** is formed of a material that includes a black material having conductivity and has a resistance value appropriate for the X electrode **1110** of the touch sensor **1100** to be formed, the black matrix **1091** and the X electrode **1110** may be formed as a single layer and the black matrix **1091** may replace the role of the X electrode as described with reference to FIGS. **13**A and **13**B.

In another example, referring to FIG. **5**C, the red phosphor layer **181**, the green phosphor layer **182**, and the blue phosphor layer **183** may be provided on the UV light emitting devices UV. In this manner, the semiconductor light emitting device may be used in the global region from a visible light to ultraviolet light UV, and extend to the form of a semiconductor light emitting device in which ultraviolet light UV is used as an excitation source of an upper phosphor.

In the exemplary embodiment, the semiconductor light emitting devices **150** are positioned on the conductive bonding layer **130** to form unit pixels in the display apparatus. Since the semiconductor light emitting devices **150** have excellent luminance, the semiconductor light emitting devices **150** may form individual unit pixels even with a small size. A length of one side of individual semiconductor light emitting device **150** may be 80 μm or smaller and the individual semiconductor light emitting device **150** may be a rectangular or square device. When the semiconductor light emitting device **150** has a rectangular shape, the semiconductor light emitting device **150** may have a size of 20×80 μm or smaller.

Also, even when a square semiconductor light emitting device **150** in which one side thereof is 10 μm is used as a unit pixel, sufficient brightness of the display apparatus can be obtained. Thus, in case of a rectangular pixel in which one side has a length of 600 μm and the other side is 300 μm, for example, distances between the semiconductor light emitting devices are sufficiently large, and thus, in this case, a flexible display apparatus having HD image quality can be implemented.

Meanwhile, even in this case, in order to increase contrast and reflect external light, the display unit **1000***a* may further include the black matrix **1091** disposed between a plurality of rows of the semiconductor light emitting devices. The black matrix **1091** may be disposed between the red phosphor layer **1081**, the green phosphor layer **1082**, and the blue phosphor layer **1083**, and even in this structure, like the structure as described above, the X electrode **1110** of the touch sensor **1100** may be disposed in a position where the black matrix **1091** is disposed. Thus, the X electrode **1110** of the touch sensor **1100** may be positioned between the red phosphor layer **1081**, the green phosphor layer **1082**, and the blue phosphor layer **1083**. Meanwhile, although not shown, when the black matrix **1091** is formed of a material that includes a black material having conductivity and has a resistance value appropriate for the X electrode **1110** of the touch sensor **1100** to be formed, the black matrix **1091** and the X electrode **1110** may be formed as a single layer and the black matrix **1091** may replace the role of the X electrode as described with reference to FIGS. **13**A and **13**B.

Various structures of one electrode of the touch sensor in the display unit **1000***a* will be described in detail with reference to the accompanying drawings. FIGS. **15**A, **15**B, **15**C, and **15**D are conceptual views illustrating various configurations in which electrodes of a touch sensor are disposed in a black matrix (or various structures of electrodes).

For example, as illustrated in FIG. **15**A, one surface of the X electrode **1110***a* of the touch sensor **1100** may be stacked on the conductive bonding layer **1030** to face the conductive bonding layer **1030**. In this case, a black matrix **1091***a* may be formed to cover other surfaces excluding one surface (a contact surface where the black matrix and the X electrode are in contact). According to this structure, the X electrode **1110***a* may not be in contact with phosphors. In this case, the width of the black matrix **1091***a* may be greater than that of the X electrode **1110***a*. The X electrode **1110***a* is covered by the black matrix **1091***a* and, in this case, the X electrode **1110***a* is not exposed outwardly.

In another example, as illustrated in FIG. **15**B, one black matrix **1091***b* may include a plurality of X electrodes **1110***b* and **1110***b*'. Namely, electrode lines corresponding to the plurality of X electrodes **1110***b* and **1110***b*' may be disposed together in one black matrix **1091***b*. As illustrated, the plurality of X electrodes **1110***b* and **1110***b*' are disposed in both ends of one black matrix **1091***b*, and spaces between the plurality of X electrodes **1110***b* and **1110***b*' are filled with the black matrix **1091***b*. Also, the plurality of X electrodes **1110***b* and **1110***b*' are covered by the black matrix **1091***b*. For this structure, the black matrix **1091***b* has two layers with different widths.

In a specific configuration, one surface of each of the plurality of X electrodes **1110***b* and **1110***b*' may face the conductive bonding layer **1030**, one of surfaces perpendicular to the one surface may face the phosphors **1080**, and the other surfaces may be covered by the black matrix **1091***b*. In this case, a portion of one surface of the black matrix **1091***b* may be combined with the conductive bonding layer **1030** and the other remaining portions excluding the portion of the one surface of the black matrix **1091***b* may be in contact with the X electrodes **1110***b* and **1110***b*'. As illustrated, the X electrodes **1110***b* and **1110***b*' may be positioned in both ends of one surface of the black matrix **1091***b*.

In another example, as illustrated in FIG. **15**C, an X electrode **1110***c* of the touch sensor **1100** may be disposed in an upper portion of a black matrix **1091***c*. In a specific example, a recess depressed toward the wiring board is formed on an upper surface of the black matrix **1091***c*, and the X electrode **1110***c* may be accommodated in the recess. The recess may be formed in a central portion of the black matrix **1091***c*, and thus, the width of the X electrode **1110***c* may be smaller than the black matrix **1091***c*.

However, the present disclosure is not limited thereto and the recess may be formed at any one of edges of the black matrix **1091***c* or in both edge portions of the black matrix **1091***c*. Recesses may be formed at both edges of the black matrix **1091***c* and a plurality of X electrodes **1110***c* may be stacked on the line of one black matrix **1091***c*.

Since the X electrode **1110***c* is accommodated in the recess, even though the X electrode **1110***c* is disposed in the upper portion of the black matrix **1091***c*, namely, even though one surface of the X electrode **1110***c* faces outwards, reflection of external light is not significant in the display apparatus.

In another example, as illustrated in FIG. **15**D, an X electrode **1110***d* of the touch sensor **1100** may be disposed above a black matrix **1091***d* but not covered by the black matrix **1091***d*. In detail, the width of the X electrode **1110***d* is smaller than the black matrix **1091***d* and the X electrode **1110***d* forms a line on an upper surface of the black matrix **1091***d*. In this structure, the X electrode **1110***d* may be formed on the upper surface of the black matrix **1091***d* through plating, deposition, printing, or the like.

In another example, the X electrode **1110***d* may be formed on a lower surface of a spacer **1120***d*. Namely, the X electrode **1110***d* is formed on a lower surface of the spacer **1120***d* to form an electrode film, and the electrode film may cover an upper surface of the display unit. In this case, the spacer **1120***d* as an electrode film of the X electrode is stacked with the electrode **1140** including the Y electrode **1130**. To this end, as illustrated, the black matrix **1091***d* is formed to have a height lower than the phosphor layer in a thickness direction of the display apparatus, and the electrode film of the X electrode may be formed to accommodate the X electrode **1110***d* in a space formed due to the height difference.

The structure of the display apparatus described above may also be applied to a vertical semiconductor light emitting device. Hereinafter, a vertical structure will be described with reference to FIGS. **16** and **17**. FIG. **16** is a perspective view illustrating a display apparatus using a semiconductor light emitting device according to another exemplary embodiment of the present disclosure, and FIG. **17** is a cross-sectional view taken along line C-C of FIG. **16**.

Referring to the drawings, the display apparatus may be a display apparatus using a passive matrix (PM) type vertical semiconductor light emitting device.

The display apparatus **1600** may include a display unit **1600***a* forming screen information by emitting R, G, and B light and a touch sensor **1700** sensing a touch input applied to the display apparatus **1600**. Hereinafter, in the exemplary embodiment or the modified example described hereinafter, the like or similar reference numerals are given to components identical or similar to those of the former example, and redundant description thereof will be omitted.

The display apparatus **1600** includes a board **1610**, a conductive bonding layer **1630**, and a plurality of semiconductor light emitting devices **1650**. Hereinafter, the descriptions of components of the present exemplary embodiment same as or similar to those of the exemplary embodiment illustrated in FIGS. **7** through **9** will be used as descriptions of the present exemplary embodiment, and only different parts will be mainly described.

The board **1610** is a wiring board and may be any one of flexible polyimide (PI), polyethylene naphthalate (PEN), and polyethylene terephthalate (PET) boards. Also, as in the former exemplary embodiment, a first electrode **1620** is formed on the board **1610**. The conductive bonding layer **1630** is formed on a plane on which the first electrode **1620** is positioned. The conductive bonding layer **1630** may be an anisotropy conductive film (ACF), anisotropy conductive paste, or a solution containing conductive particles, for example. Hereinafter, a case in which the conductive bonding layer **1630** is formed by an anisotropic conductive film will be described.

The semiconductor light emitting devices **1650** may have a vertical structure and combined with the conductive bonding layer **1630**. A plurality of second electrodes **1640** may be disposed between the vertical semiconductor light emitting devices **1650** in a direction crossing a length direction of the first electrode **1620** and positioned to be electrically connected to the semiconductor light emitting devices **1650**. In this case, the second electrodes **1640** are disposed on the conductive bonding layer **1630**.

For example, the first electrode **1620** and the second electrodes **1640** are disposed in mutually crossing directions, and as in the former exemplary embodiment, the first electrode **1620** may be a vertical electrode and the second electrodes **1640** may be horizontal electrodes.

As illustrated, the plurality of semiconductor light emitting devices **1650** constitute a semiconductor light emitting device array along a plurality of electrode lines **1621**. Also, a phosphor may be staked along each of the plurality of electrode lines. Thus, in the first electrode **1620**, one electrode line may be an electrode controlling a color. Thus, red (R), green (G), and blue (B) phosphors may be disposed in sequence along the second electrodes **1640**, and thus, unit pixels may be implemented.

The plurality of semiconductor light emitting devices **1650** are combined with the conductive bonding layer **1630**, forming a plurality of rows along at least one of the plurality of electrode lines.

As illustrated, the plurality of semiconductor light emitting devices **1650** may form a plurality of rows in a direction parallel to the plurality of electrode lines provided in the first electrode **1620**. However, the present disclosure is not limited thereto.

In addition, the display unit **1600***a* may further include a phosphor layer **1680** formed on one surface of the plurality of semiconductor light emitting devices **1650**. For example, the semiconductor light emitting device **1650** may be a blue semiconductor light emitting device emitting blue (B) light, and the phosphor layer **1680** serves to convert the blue (B) light into a color of a unit pixel. The phosphor layer **1680** may be a red phosphor **1681** or a green phosphor **1682** constituting an individual pixel. Namely, in a position forming a red unit pixel, the red phosphor **1681** capable of converting blue light into red (R) light may be stacked on the blue semiconductor light emitting device **1650**, and in a position forming a green unit pixel, the green phosphor **1682** capable of converting blue light into green (G) light may be stacked on the blue semiconductor light emitting device **1650**. Also, in a portion forming a blue unit pixel, only the blue semiconductor light emitting device **1650** may be used alone. In this case, the red (R), green (G), and blue (B) unit pixels may constitute a single pixel, respectively. In detail, a phosphor of one color may be stacked along each line of the first electrode **1620**. Thus, one line of the first electrode **1620** may be an electrode controlling one color. However, the present disclosure is not limited thereto and the semiconductor light emitting devices **1650** and quantum dots (QD), instead of phosphors, may be combined with form unit pixels emitting red (R), green (G), and blue (B).

Meanwhile, in order to increase contrast of the phosphor layer **1680**, the display unit **1600***a* may further include a black matrix **1691** disposed between phosphors. The black matrix **1691** may absorb reflection of external light and increase the contrast. The black matrix **1691** is positioned between the phosphor layers **1680** along the first electrode **1620** in a direction in which the phosphor layers **1680** are stacked.

The touch sensor **1700** operating cooperatively with the display unit **1600***a* including the configuration as described above includes an X electrode **1710**, a Y electrode **1730** stacked on the display unit, and a spacer **1720** separating the X and Y electrodes **1710** and **1730**. The X and Y electrodes **1710** and **1730** are arranged in directions in which they cross each other, and receive electric charges from a power supply unit (not shown). Thus, in a state in which a potential difference is formed between the X and Y electrodes **1710** and **1730**, when the display apparatus **1600** is touched with a conductor, for example, a user's finger, or the like, quantities of electric charge charged in the X and Y electrodes **1710** and **1730** are changed, respectively. Based on the change in the quantities of electric charges, the controller (not shown) may calculate positions of an X axis and a Y axis, and a touched input point may be specified by the calculation value. Meanwhile, in the present disclosure, the X electrode and the Y electrode are relative concepts, rather than having a general meaning of the terms. Thus, the X electrode is not necessarily identical to an X-axis direction and the Y electrode is not necessarily identical to an Y-axis direction. Namely, When any one of the X electrode and the Y electrode is in the X-axis direction, the other may be in the Y-axis direction.

Positions of the X electrode **1710** and the Y electrode **1730** of the touch sensor **1700** in the display apparatus **1600** will be described in detail. As illustrated, the X electrode **1710** of the touch sensor **1700** is disposed between the semiconductor light emitting devices **1650** forming a plurality of rows along the first electrode **1610** in the display unit **1100***a*. In detail, as illustrated in FIG. **17**, the X electrode **1710** may be disposed between the plurality of rows on the conductive bonding layer **1630**.

The X electrode **1710** includes a plurality of electrode lines, and the plurality of electrode lines of the X electrode **1710** are disposed to be separated in a horizontal direction between the semiconductor light emitting devices **1650** forming the plurality of rows. Thus, in the display apparatus using the vertical semiconductor light emitting devices, the X electrode **1710** may be positioned in the position of the black matrix **1691** (between the phosphor layers or between the semiconductor light emitting devices). In a case in which the X electrode **1710** is disposed in the position of the black matrix **1691**, the X electrode **1710** may be formed to be covered by the black matrix **1691** or may cover the black matrix **1691**.

In this manner, since the electrodes **1710** and the black matrix **1691** overlap, the black matrix **1691** and the X electrode **1710** may be positioned together between the phosphor layers in the display apparatus using vertical semiconductor light emitting devices.

In addition, the X electrode **1710** of the touch sensor **1700** may be positioned inside the display unit **1600***a*, while the Y electrode **1730** of the touch sensor **1700** may be positioned outside the display unit **1600***a*. In the present exemplary embodiment, as positions, shapes, functions, and structures of the X electrode **1710** and the Y electrode **1730**, the electrode film **1740**, and the spacer **1720** of the touch sensor **1700**, those of the X electrode **1110** and the Y electrode **1130**, the electrode film **1140**, and the spacer **1120** of the display apparatus employing the flipchip type light emitting device described above with reference to FIGS. **12**A and **12**B are applied, and descriptions thereof will replace with the descriptions of the former exemplary embodiment.

As described above, in the display apparatus **1600** according to an exemplary embodiment of the present disclosure, by positioning any one of the X electrode **1710** and the Y electrode **1720** forming the touch sensor **1700** in the display unit **1600***a*, a thickness of the touch sensor **1700** in a Z-axis direction can be reduced.

Meanwhile, the black matrix **1691** as described above may be formed of a material having a resistance value different from that of the X electrode **1110** and including a black material. Also, the black material **1691** may be formed of a material having conductivity. Thus, in a case in which the black matrix **1691** has a resistance value different from that of one electrode of the touch sensor **1700**, as illustrated in FIGS. **16** and **17**, the X electrode **1710** and the black matrix **1691** may be stacked at corresponding positions.

For example, when the black matrix **1691** is formed of a material including a black material and having a resistance value appropriate for the X electrode **1710** of the touch sensor **1700** to be formed, as illustrated in FIGS. **13**A and **13**B, the X electrode **1710** of the touch sensor **1700** and the black matrix **1691** may be formed as a single layer. In this manner, one electrode of the touch sensor may serve as both an electrode and a black matrix. Thus, in this case, the black matrix may be both a component of the display unit and a component of the touch sensor.

Hereinafter, another example of a structure of a touch sensor disposed in a display unit will be described in detail with reference to the accompanying drawings. FIG. **18** is a perspective view illustrating a display apparatus using a semiconductor light emitting device according to another exemplary embodiment of the present disclosure, and FIGS. **19**A and **19**B are cross-sectional views taken along line B-B and C-C of FIG. **18**.

As illustrated in FIGS. **18**, **19**A, and **19**B, the display apparatus **1000** using a passive matrix (PM) type semiconductor light emitting device is illustrated as a display apparatus **1800** using a semiconductor light emitting device. However, the present disclosure described hereinafter may also be applied to an active matrix (AM) type semiconductor light emitting device.

The display apparatus **1800** may include a display unit **1800***a* forming screen information by emitting R, G, and B light and a touch sensor **1900** sensing a touch input applied to the display apparatus **1800**. Hereinafter, in the exemplary embodiment or the modified example described hereinafter, the like or similar reference numerals are given to components identical or similar to those of the former example, and redundant description thereof will be omitted.

The display unit **1800***a* includes a board **1810**, a first electrode **1820**, a conductive bonding layer **1830**, a second electrode **1840**, and a plurality of semiconductor light emitting devices **1850**. Here, the first electrode **1820** and the second electrode **1840** may include a plurality of electrode lines, respectively.

The board **1810** may be a wiring board on which a plurality electrode lines included in the first electrode **1820** are disposed, and thus, the first electrode **1820** may be positioned on the board **1810**. Also, the second electrode **1840** is disposed on the board **1810**. For example, the board **1810** may be a wiring board including a plurality of layers, and the first electrode **1820** and the second electrode **1840** may be formed on each of the plurality of layers. In this case, the wiring board may be a board in which the board **110** and the insulating layer **160** of the display apparatus described above with reference to FIGS. **3**A and **3**B are integrally formed of a material having insulating properties and flexibility such as polyimide (PI), PET, PEN, or the like.

As illustrated, the first electrode **1820** and the second electrode **1830** are electrically connected to a plurality of semiconductor light emitting devices **1850**. In this case, the first electrode **1820** may be connected to the plurality of semiconductor light emitting devices **1850** by the medium of an auxiliary electrode **1870** disposed to be coplanar with the second electrode **1830**. The first electrode **1820** and the second electrode **1840** may be electrically connected to the plurality of semiconductor light emitting devices **1850** by a conductive bonding layer **1830** disposed on one surface of the board **1810**.

The conductive bonding layer **1830** may be a layer having adhesion and conductivity, and to this end, the conductive bonding layer **1830** may be formed of a mixture of a material having conductivity and a material having adhesion. Also, the conductive bonding layer **1830** may have ductility to enable the display apparatus to have a flexible function. In a state in which the auxiliary electrode **1870** and the second electrode **1840** are positioned, the conductive bonding layer **1830** is formed, and thereafter, when the semiconductor light emitting devices **1850** are connected in a flipchip manner by applying heat and pressure thereto, the semiconductor light emitting devices **1850** are electrically connected to the first electrode **1820** and the second electrode **1840**.

In this manner, the plurality of semiconductor light emitting devices **1850** are coupled to the conductive bonding layer **1830**, forming a plurality of rows along at least one of the plurality of electrode lines. As illustrated, the plurality of semiconductor light emitting devices **1850** may form a plurality of rows in a direction parallel to the plurality of electrode lines provided in the first electrode **1820**. However, the present disclosure is not limited thereto, and for example, the plurality of semiconductor light emitting devices **1850** may form a plurality of rows along the second electrode **1840**.

In addition, the display unit **1800***a* may further include a phosphor layer **1880** formed on one surface of the plurality of semiconductor light emitting devices **1850**. For example, the semiconductor light emitting device **1850** may be a blue semiconductor light emitting device emitting blue (B) light, and the phosphor layer **1880** serves to convert the blue (B) light into a color of a unit pixel. The phosphor layer **1880** may be a red phosphor **1881** or a green phosphor **1882** constituting an individual pixel. Namely, in a position forming a red unit pixel, the red phosphor **1881** capable of converting blue light into red (R) light may be stacked on the blue semiconductor light emitting device **1850**, and in a position forming a green unit pixel, the green phosphor **1882** capable of converting blue light into green (G) light may be stacked on the blue semiconductor light emitting device **1850**. Also, in a portion forming a blue unit pixel, only the blue semiconductor light emitting device **1850** may be used alone. In this case, the red (R), green (G), and blue (B) unit pixels may constitute a single pixel, respectively. In detail, a phosphor of one color may be stacked along each line of the first electrode **1820**. Thus, one line of the first electrode **1820** may be an electrode controlling one color. Namely, the red (R), green (G), and blue (B) phosphors may be disposed in sequence along the second electrode **1840**, thus forming unit pixels. However, the present disclosure is not limited thereto and the semiconductor light emitting devices **1850** and quantum dots (QD), instead of phosphors, may be combined with form unit pixels emitting red (R), green (G), and blue (B).

Meanwhile, in order to increase contrast of the phosphor layer **1880**, the display unit **1800***a* may further include a black matrix **1891** disposed between phosphors. The black matrix **1891** may absorb reflection of external light and increase the contrast. The black matrix **1891** is positioned between the phosphor layers **1880** along the first electrode **1820** in a direction in which the phosphor layers **1880** are stacked.

According to an exemplary embodiment of the present disclosure, any one of the first and second electrodes **1820** and **1840** may be an X electrode or a Y electrode of the touch sensor **1900**. For example, the touch sensor **1900** may utilize any one of the first and second electrodes **1820** and **1840** of the display unit **1800***a*, as an X electrode. Hereinafter, in the present exemplary embodiment, any one of the first and second electrodes **1820** and **1840** is utilized as an X electrode, but any one of the first and second electrodes **1820** and **1840** may become the Y electrode.

The touch sensor **1900** includes the Y electrode **1930** and a spacer **1920** stacked on the display unit. Thus, the Y electrode **1930** may be arranged in a direction crossing any one of the first and second electrodes **1820** and **1840**. As illustrated, among the first and second electrodes **1820** and **1840**, the first electrode **1820** is utilized as an X electrode of the touch sensor **1900**.

Thus, the touch sensor **1900** may sense a touch input based on a change in a quantity of electric charge between any one (i.e., the first electrode) among the first and second electrodes **1820** and **1840** and the Y electrode **1930**.

The controller (not shown) of the display apparatus **1800** controls the semiconductor light emitting devices **1850** through a first signal transmission line formed by the first and second electrodes **1820** and **1840**, and processes the sensed touch input through a second signal transmission line formed by the first electrode **1820** and the Y electrode **1930**. Namely, a driving signal of the semiconductor light emitting devices **1850** may be generated by generating a first potential difference between the first and second electrodes **1820** and **1840**, and sensing of a touch input by the touch sensor **1900** may be generated due to a change in a second potential difference formed through a second signal transmission line formed by the first electrode **1820** and the Y electrode **1930**. However, the present disclosure is not limited thereto and the second signal transmission line may be a signal transmission line formed by combining the second electrode **1840** and the Y electrode **1930**.

In this manner, in the present exemplary embodiment, by positioning one electrode of the touch sensor **1900** inside the display unit **1800***a*, a thickness of the touch sensor **1900** may be reduced. Also, the Y electrode **1930** of the touch sensor **1900** may be positioned outside the display unit **1800***a*. As illustrated, the Y electrode **1930** is disposed to overlap the plurality of semiconductor light emitting devices **1850** outside the display unit **1800***a* and combined with the first electrode **1820** to sense a touch input.

The Y electrode **1930** may be formed on an electrode film **1940** formed of a light-transmissive material allowing light emitted from the plurality of semiconductor light emitting devices **1850** to be transmitted therethrough. As illustrated, the Y electrode **1930** may protrude from one surface of the electrode film **1940** and may be formed inside the electrode film **1940**. In a case in which the Y electrode **1930** is formed inside the electrode film **1940**, the electrode film **1940** may be formed as a plurality of layers.

The spacer **1920** of the touch sensor **1900** may be formed as a light-transmissive member to allow light emitted from the plurality of semiconductor light emitting devices **1850** to be transmitted therethrough. The spacer **1920** is disposed between the electrode film **1940** and the plurality of semiconductor light emitting devices **1850**. Like the spacer illustrated in FIGS. **12**A and **12**B or like the spacer illustrated in FIG. **14**A, the spacer **1920** may be, for example, an optically clear adhesive (OCA) (or an optically clear adhesive film), a non-reflection film (or a low reflection film), a transparent resin, or the like. Also, the spacer **1920** may have a structure in which at least a pair of the OCA, the non-reflection film (or low-reflection film) and a transparent resin are stacked. Descriptions of the spacer **1920** will be replaced with the descriptions of the spacer illustrated in FIGS. **12**A and **12**B or the descriptions of the spacer illustrated in FIG. **14**A.

Meanwhile, the controller may appropriately process signals such that a driving signal for driving the semiconductor light emitting devices **1850** and a change in a quantity of an electric charge of a touch input applied to the touch sensor **1900** are not affected each other although the semiconductor light emitting devices **1850** and the touch sensor **1900** share any one of the first and second electrodes **1820** and **1840**.

For example, a case in which the Y electrode **1900** of the touch sensor **1900** forms a second signal transmission line with the second electrode **1820** of the display unit **1800***a* will be described together with FIG. **20**. Here, the first electrode **1820** may be a data electrode and the second electrode **1840** may be a scan electrode. Also, Vd corresponds to a voltage applied to the first electrode **1820**, and Vs**1**, Vs**2**, Vs**3**, . . . , Vn respectively correspond to voltages applied to a plurality of electrode lines included in the second electrode **1840**. The semiconductor light emitting devices provided in the display unit **1800***a* are turned on based on potential differences formed between Vd and Vs**1** and Vd and Vs**2**, Vs**3**, . . . , Vn.

For example, in a case in which a voltage ΔV is applied to both Vd and Vs**1**, since Vd and Vs**1** do not have a potential difference therebetween, semiconductor light emitting devices electrically connected to electrodes corresponding to Vd and Vs**1** are not turned on. When Vd and Vs**1** has a potential difference as in a section 'a', since a potential difference is formed between Vd and Vs**1**, the semiconductor light emitting devices electrically connected to the electrodes corresponding to Vd and Vs**1** are turned on. Thus, as illustrated, in the section 'a', the semiconductor light emitting devices electrically connected to the electrodes corresponding to Vd and Vs**1** emit light, in a section 'b', semiconductor light emitting devices electrically connected to electrodes corresponding to Vd and Vs**2** emit light, and in a section 'c', semiconductor light emitting devices electrically connected to electrodes corresponding to Vd and Vs**3** emit light, and in a section 'd', semiconductor light emitting devices electrically connected to electrodes corresponding to Vd and Vsn emit light.

Meanwhile, in order not to be affected by a potential difference formed between Vd and Vs**1**, Vs**2**, Vs**3**, . . . , Vn, the touch sensor **1900** may be designed not to react with a change in a potential difference between 0 to ΔV as a reference potential to be formed between Vd and Vs**1**, Vs**2**, Vs**3**, . . . , Vn. Namely, the touch sensor **1900** may be designed to recognize a touch input when a potential higher than ΔV is sensed. To this end, a voltage higher than a magnitude of ΔV may be applied to the Y electrode, and an influence of a potential difference formed between Vd and Vs**1**, Vs**2**, Vs**3**, . . . , Vn may be processed as noise in detecting a touch input.

Thus, the display apparatus **1800** may be designed such that a first potential difference between the first and second electrodes **1820** and **1840** related to driving of the semiconductor light emitting devices **1850** is lower than a second potential difference formed between the second electrode **1840** and the Y electrode to sense a touch input. Accordingly, an influence (for example, the second potential difference is increased or decreased by the first potential difference) of the generation of the first potential difference on the second potential difference may be processed as noise in detecting the touch input.

Here, a magnitude of voltages applied to the first and second electrodes **1820** and **1840** may be lower than that of a voltage applied to the Y electrode **1930**.

A method for appropriately processing a signal such that a driving signal for driving the semiconductor light emitting devices **1850** and a change in a quantity of electric charge of a touch input applied to the touch sensor **1900** are not affected each other even though the semiconductor light emitting devices **1850** and the touch sensor **1900** share any one of the first and second electrodes **1820** and **1840** will be described as another example.

Here, Vd corresponds to a voltage applied to the first electrode **1820**, and Vs**1**, Vs**2**, Vs**3**, . . . , Vn respectively correspond to voltages applied to a plurality of electrode lines included in the second electrode **1840**. The semiconductor light emitting devices provided in the display unit **1800***a* are turned on based on potential differences formed between Vd and Vs**1** and Vd and Vs**2**, Vs**3**, . . . , Vn. For example, in a state in which a voltage having a predetermined magnitude is applied to Vd, when a minus voltage is applied to any one of Vs**1**, Vs**2**, Vs**3**, . . . , Vn to allow the any one to have a potential of ΔV, semiconductor light emitting devices electrically connected to Vd and the any one of Vs**1**, Vs**2**, Vs**3**, . . . , Vn may be turned on. In this case, as the minus voltage is applied in a state in which a voltage is not applied to Vs**1**, Vs**2**, Vs**3**, . . . , Vn (in a state in which voltage 0V is applied), ΔV may be generated.

Thus, in a section 'a' in which the voltage ΔV is applied to Vs**1**, the semiconductor light emitting devices electrically connected to the electrodes corresponding to Vd and Vs**1** emit light, in a section 'b', semiconductor light emitting devices electrically connected to electrodes corresponding to Vd and Vs**2** emit light, and in a section 'c', semiconductor light emitting devices electrically connected to electrodes corresponding to Vd and Vs**3** emit light, and in a section 'd', semiconductor light emitting devices electrically connected to electrodes corresponding to Vd and Vsn emit light.

Meanwhile, in order not to be affected by formation of a potential difference with Vd as a voltage is applied to the second electrode **1840**, namely, to Vs**1**, Vs**2**, Vs**3**, . . . , Vn, the touch sensor **1900** may be designed such that a potential of the Y electrode is changed to be identical to the potential of Vs**1**, Vs**2**, Vs**3**, . . . , Vn electrodes. Namely, in the touch sensor **1900**, a potential of the Y electrode **1930** may be changed when a potential of the second electrode **1840** is changed, such that a potential difference between Vs**1**, Vs**2**, Vs**3**, . . . , Vn and the Y electrode **1930** is maintained. For example, as illustrated, a change in potentials of the second electrode **1840**, namely, Vs**1**, Vs**2**, Vs**3**, . . . , Vn and the Y electrode are generated in the form of a pulse, respectively, and a point in time at which the pulse is generated and a magnitude of the pulse may be generated in the same manner in the touch sensor and the display unit. Thus, potentials of the second electrode **1840** and the Y electrode **1930** may be generated at the same time and with magnitude.

As described above, according to an exemplary embodiment of the present disclosure, by utilizing any one of the first and second electrodes of the display unit, as an electrode of the touch sensor, a thickness of the touch sensor can be reduced.

So far, the case in which the display unit **1800***a* includes the blue semiconductor light emitting device that emit blue (B) light has been described, but the present disclosure is not limited thereto and any other structure implementing blue, red, and green may be applied. FIGS. **22**A, **22**B, and **22**C are conceptual views illustrating various configurations implementing color in relation to a flipchip type semiconductor light emitting device to which the present invention is applied and various types of stacked structures for implementing touch sensors.

Descriptions of the configuration of the display unit **1800***a* illustrated in FIGS. **22**A, **22**B, and **22**C will be replaced with the descriptions of FIGS. **5**A, **5**B, and **5**B. As illustrated, in the display apparatus **1800**, any one of the first electrode **1820** and the second electrode **1840** of the display unit **1800***a* including a blue semiconductor light emitting device that emits blue (B) light and other semiconductor light emitting device, may be utilized as an electrode of the touch sensor **1900**. In the display apparatus **1800**, the touch sensor **1900** includes the Y electrode **1930** and the spacer **1920**, and the spacer **1920** may be stacked on the display unit **1800***a* or the phosphor layer. Thus, the touch sensor **1900** may sensed a touch input based on a change in a quantity of electric charge between any one of the first and second electrodes **1820** and **1840** and the Y electrode **1930**.

Meanwhile, in the display apparatus according to an exemplary embodiment of the present disclosure, by utilizing any one of the first and second electrodes of the display unit as an X electrode of the touch sensor and by positioning the Y electrode between the semiconductor light emitting devices forming a plurality of rows, both the X and Y electrodes of the touch sensor may be positioned in the display unit.

FIG. **23** is a cross-sectional view illustrating a structure in which electrodes of the touch sensor are disposed on the display unit of the display apparatus of FIG. **18**. As illustrated, the display unit **1800***a* includes the first electrode **1820** and the second electrode **1840** electrically connected to the plurality of semiconductor light emitting devices **1850** and arranged in mutually crossing directions, and any one of the first electrode **1820** and the second electrode **1840** may be formed to have a potential difference with respect to the Y electrode **1930** such that the any one of the first electrode **1820** and the second electrode **1840** becomes an X electrode of the touch sensor **1900**. The Y electrode **1930** is disposed between the plurality of semiconductor light emitting devices **1850** arranged to form a plurality of rows and combined with any one of the first electrode **1820** and the second electrode **1840** to sense a touch input.

In a position where the black matrix **1891** is disposed, the Y electrode **1930** may be stacked on the black matrix **1891**. The Y electrode **1930** may be stacked to be in contact with the conductive bonding layer **1830** and may be covered by the back matrix **1891**. Meanwhile, an electrode structure of the touch sensor **1900** and the black matrix **1891** may be combined variously, and detailed descriptions thereof will be replaced with the descriptions of FIGS. **15**A, **15**B, **15**C, and **15**D. Also, when both the X electrode and Y electrode **1930** of the touch sensor **1900** are positioned in the display unit **1800***a*, the X electrode and Y electrode **1930** may be spaced by at least any one of the conductive bonding layer **1830** and the insulating layer **1860** of the display unit **1800***a*.

Since any one of the first electrode **1820** and the second electrode **1840** becomes an X electrode of the touch sensor **1900**, the Y electrode **1930** of the touch sensor **1900** forms a second signal transmission line with any one of the first electrode **1820** and the second electrode **1840**, for sensing a touch. In this case, the signal processing scheme described above with reference to FIGS. **20** and **21** may be employed to perform signal processing, and detailed descriptions thereof will be replaced with the description of FIGS. **20** and **21**.

Thus, in this case, all the components for forming the touch sensor may be positioned on the display unit **1800***a*, and thus, a thickness of the display apparatus in the Z axis direction can be significantly reduced.

Hereinafter, another example of the structure of the touch sensor disposed in the display unit will be described in detail with reference to the accompanying drawings. FIG. **24** is a perspective view illustrating a display apparatus using a semiconductor light emitting device according to another exemplary embodiment of the present disclosure, FIG. **25** is a cross-sectional view taken along line C-C of FIG. **16**, and FIG. **26** is a cross-sectional view illustrating a structure in which electrodes of the touch sensor is disposed on a display unit of the display apparatus of FIG. **24**.

Referring to FIGS. **24** and **25**, a display apparatus using a passive matrix (PM) type vertical semiconductor light emitting device is illustrated as a display apparatus **2400** using a semiconductor light emitting device. However, the present disclosure described hereinafter may also be applied to an active matrix (AM) type semiconductor light emitting device.

Descriptions of the configuration and structure of the display unit **1800***a* illustrated in FIGS. **24** and **25** will be replaced with the descriptions of FIGS. **16** and **17** as discussed above.

As illustrated, even when the passive matrix (PM) type vertical semiconductor light emitting device is used in the display apparatus **2400**, any one of first and second electrodes **2420** and **2440** included in the display apparatus **2400** may be utilized as an X electrode of a touch sensor **2500**. The touch sensor **2500** includes an Y electrode **2530** and a spacer **2520** stacked on the display unit **2400***a*. thus, the Y electrode **2530** may be arranged in a direction crossing any one of the first and second electrodes **2420** and **2440**. As illustrated, among the first and second electrodes **2420** and **2440**, the first electrode **2420** is utilized as an X electrode of the touch sensor **2500**.

Thus, the touch sensor **2500** may sense a touch input based on a change in a quantity of an electric charge between any one of the first and second electrodes **2420** and **2440** and the Y electrode **2530**. Descriptions of signal processing and controlling of the display unit **2400***a* and the touch sensor **2500** in a case in which any one of the electrodes of the display unit **2400***a* is used as an electrode of the touch sensor **2500** will be replaced with the descriptions of FIGS. **18**, **19**A, **19***b*, **21**, and **22** as discussed above.

Meanwhile, in the display apparatus according to an exemplary embodiment of the present disclosure, as illustrated in FIG. **26**, by utilizing any one of first and second electrodes of the display unit, as an X electrode of the touch sensor, and positioning the Y electrode of the touch sensor between the vertical semiconductor light emitting devices forming a plurality of rows, both the X and Y electrodes of the touch sensor may be positioned in the display unit.

FIG. **26** is a cross-sectional view illustrating a structure in which electrodes of the touch sensor are disposed on the display unit of the display apparatus described above with reference to FIG. **24**. As illustrated, the display unit **2400***a* includes the first electrode **2420** and the second electrode **2440** electrically connected to the plurality of semiconductor light emitting devices **2450** and arranged in mutually crossing directions, and any one of the first electrode **2420** and the second electrode **2440** may be formed to have a potential difference with respect to the Y electrode **2530** such that the any one of the first electrode **2420** and the second electrode **2440** becomes an X electrode of the touch sensor **2500**. The Y electrode **2530** is disposed between the plurality of semiconductor light emitting devices **2450** arranged to form a plurality of rows and combined with any one of the first electrode **2420** and the second electrode **2440** to sense a touch input. In a position where the black matrix **2491** is disposed, the Y electrode **2530** may be stacked on the black matrix **2491**. Meanwhile, an electrode structure of the touch sensor **2500** and the black matrix **2491** may be combined variously, and detailed descriptions thereof will be replaced with the descriptions of FIGS. **15**A, **15**B, **15**C, and **15**D. Also, in this case, the signal processing scheme described above with reference to FIGS. **20** and **21** may be employed to perform signal processing and controlling to sense a touch, and detailed descriptions thereof will be replaced with the description of FIGS. **20** and **21**.

Also, when both the X electrode and Y electrode **2530** of the touch sensor **2500** are positioned in the display unit **2400***a*, the X electrode and Y electrode **2530** may be spaced by at least any one of the conductive bonding layer **2430** and the insulating layer **2460** of the display unit **2400***a*. Thus, in this case, since all the components for forming the touch sensor may be positioned on the display unit **2400***a*, a thickness of the display apparatus in the Z axis direction can be significantly reduced.

Also, since the X electrode and the Y electrode of the touch sensor are not formed on electrode films such as ITO films, damage to the electrode films in the touch sensor may be prevented or alleviated when the flexible display apparatus is bent.

The display apparatus using a semiconductor light emitting device described above is not limited to the configurations and methods of the exemplary embodiments described above, but the entirety or a portion of the embodiments can be selectively combined with be configured into various modifications.

The foregoing exemplary embodiments and advantages are merely exemplary and are not to be considered as limiting the present disclosure. The present teachings can be readily applied to other types of apparatuses. This description is intended to be illustrative, and not to limit the scope of the claims. Many alternatives, modifications, and variations will be apparent to those skilled in the art. The features, structures, methods, and other characteristics of the exemplary embodiments described herein may be combined in various ways to obtain additional and/or alternative exemplary embodiments.

As the present features may be embodied in several forms without departing from the characteristics thereof, it should also be understood that the above-described exemplary embodiments are not limited by any of the details of the foregoing description, unless otherwise specified, but rather should be considered broadly within its scope as defined in the appended claims, and therefore all changes and modifications that fall within the metes and bounds of the claims, or equivalents of such metes and bounds are therefore intended to be embraced by the appended claims.

The invention claimed is:

1. A display apparatus including a touch sensor unit and a display unit controlled based on a touch input sensed through the touch sensor unit, wherein the display unit comprises:

a conductive bonding layer; and

a plurality of semiconductor light emitting devices combined with the conductive bonding layer and arranged to form a plurality of rows, and

the touch sensor unit comprises:

an X electrode disposed between the plurality of rows of the plurality of semiconductor light emitting devices in the display unit;

an Y electrode configured to be combined with the X electrode to sense a touch input, a plurality of horizontal electrode lines electrically connected to the plurality of semiconductor light emitting devices; and

a plurality of vertical electrode lines arranged in a direction crossing the plurality of horizontal electrode lines and disposed to be parallel to the X electrode.

2. The display apparatus of claim **1**, further comprising:

a black matrix disposed to cover the X electrode between the plurality of semiconductor light emitting devices.

3. The display apparatus of claim **2**, wherein phosphor layers are formed on one surfaces of the plurality of semiconductor light emitting devices, and the black matrix and the X electrode are positioned between the phosphor layers, respectively.

4. The display apparatus of claim **2**, wherein the X electrode is disposed between the conductive bonding layer and the black matrix.

5. The display apparatus of claim **2**, wherein the X electrode and the black matrix are formed of materials having different resistance values, respectively.

6. The display apparatus of claim **1**, wherein the X electrode is formed as being black to alleviate reflection between the phosphor layers provided in the display unit.

7. The display apparatus of claim **6**, wherein the X electrode is formed as a single layer between the phosphor layers.

8. The display apparatus of claim **1**, wherein the X electrode is disposed inside the display unit, the Y electrode is formed on an electrode film formed of a light-transmissive material allowing light emitted from the plurality of semiconductor light emitting devices to be transmitted therethrough, and the electrode film is disposed to overlap the plurality of semiconductor light emitting devices outside the display unit.

9. The display apparatus of claim **8**, wherein a light-transmissive member is disposed between the electrode film and the plurality of semiconductor light emitting devices to space the X and Y electrodes and allow light from the semiconductor light emitting devices to be transmitted therethrough.

10. The display apparatus of claim **1**, wherein the plurality of horizontal electrode lines and the plurality of vertical electrode lines are formed on a wiring board covered by the conductive bonding layer.

11. The display apparatus of claim **1**, wherein the display unit comprises a vertical electrode and a horizontal electrode electrically connected to the plurality of semiconductor light emitting devices and arranged in mutually crossing directions, and any one of the vertical electrode and the horizontal electrode has a potential difference from the X electrode such that the any one of the vertical electrode and the horizontal electrode becomes a Y electrode of the touch sensor unit.

12. The display apparatus of claim **11**, wherein the touch sensor unit senses a touch input through a signal transmission line formed between any one of the vertical electrode and the horizontal electrode and the X electrode.

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